EIGHTY-FIRST YEAR

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Heroes of Mapmaking

From Alaska's Snows to Dismal Swamps, Pluck and Energy Is Completing the Largest Map in the World

By Guy Elliott Mitchell
United States Geological Survey

ONE of the very considerable achievements of the year was the passage by Congress last winter, largely as a result of the activity of the engineers of the country, of the Temple Act providing for the quick completion of the topographic map of the United States.

Ever since its organization, nearly fifty years ago, the United States Geological Survey has been working away with meager annual appropriations on this great task of constructing an accurate, scientific map of the United States, a base map, a master map—a "mother map," as Secretary Garfield once called it—a map showing not only state, county and other political boundaries, the locations of towns, railroads, and such things as are found on ordinary atlas maps, but also every natural feature of the country itself—an accurate, physical map, drawn to scale in every particular, a map which is in effect an exact model in miniature of the country it represents.

You have doubtless studied models of certain projects, of a great reservoir site perhaps, or a model of the Panama Canal or some other big undertaking which the engineer desired to present to the layman's eye in graphic form. This is what the Geological Survey's standard topographic map is, an exact model, with every hill and mountain shown at its actual height above sea level, and every stream and brook shown with its correct gradient; the valleys and slopes and other features portrayed on the map are simply miniatures of the real valleys and slopes represented to scale with engineering exactness.

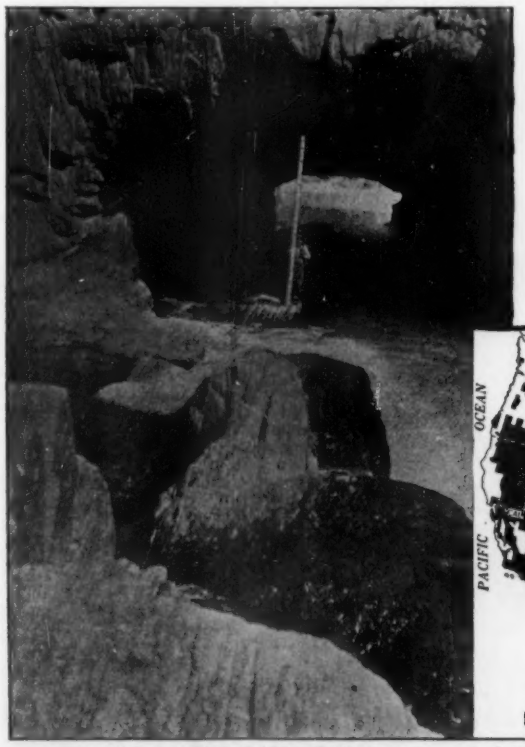
Task to be Completed in 20 Years

About 45 percent of the United States proper has been covered already by topographic maps made by the Geological Survey. But about 15 percent of these must immediately be subtracted from the 45 because of their small scale and reconnaissance character. Thirty or forty years ago these maps served as the best possible product which the really tiny appropriations then allowed by Congress could provide, but now, with the building up of the country they are quite inadequate.

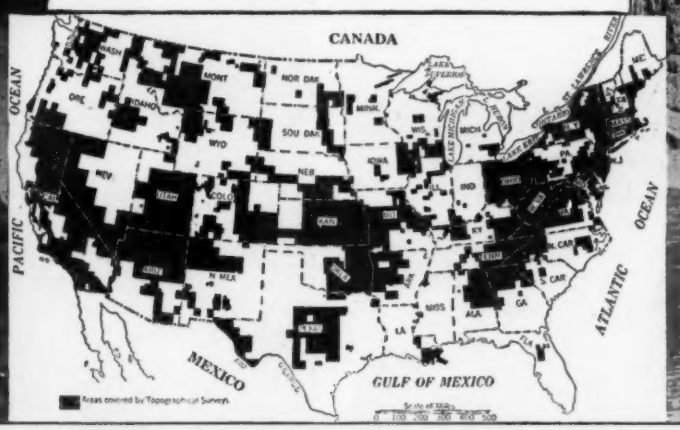
With 65 or 70 percent of the United States in need of new maps it was found that it would require the Geological Survey, at the present rate of progress, over 100 years to complete the topographic map of the country. Realizing this the Engineering Council, representing practically the entire engineering fraternity of the United States, became very active during the past two years and succeeded in getting the Temple Bill enacted into law, thus authorizing the speeding up of the work to such a degree as to complete the job within 20 years.

That the task is a huge one is seen from the fact that already over $15,000,000 has been spent, while it is estimated that it will cost an additional $50,000,000 to finish the work. Provision is made whereby the states or municipalities may cooperate with the Federal Survey, matching the Government dollar for dollar and thus pushing the work to almost any extent desired. More than half the states are already cooperating, such outside contributions for the present fiscal year being about $400,000.

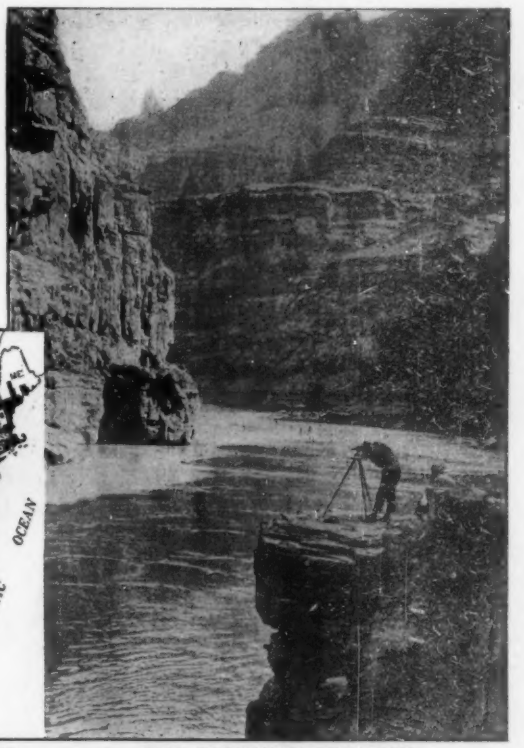
Under the Temple law there is definite promise that these cooperative contributions will be largely increased during the next few years to match in part the $1,500,000 or $2,000,000 a year which it is ex-



ALL IN THE DAY'S WORK
The rodman as well as the engineer has to get into difficult places



LAND MAPPED BY THE UNITED STATES GEOLOGICAL SURVEY
From a study of these extremely accurate maps railroads can be located or armies maneuvered



THE SURVEYOR AT WORK
Every river canyon in the United States must be instrumentally surveyed

A TOPOGRAPHIC ENGINEER

This engineer ran the 400-mile line of the Grand Canyon of the Colorado

A SIGHTING CENTER

A signal tower for triangulation "control" sighting, as used by the United States Geological Survey

HOLDING THE ROD

The engineer and the rodman cooperate closely in the work of topographic surveying

pected Congress will appropriate for the work. Col. C. H. Birdseye, the Chief Topographic Engineer of the Geological Survey, will have put upon him one of the biggest engineering jobs of the day. For topographic engineers can not be picked up at random. There is little demand for topographic engineering outside of the government service, and there are no topographic engineers being graduated from our colleges; they must be trained up in the field work of the Geological Survey itself. It will, therefore, be a couple of years at least before the Survey will be in full swing under the new law.

Meanwhile, to do the wonderfully fine copper-plate engraving by which these maps are reproduced, engravers and lithographers also must be trained in the Geological Survey's big engraving and printing plant.

At the present time the Geological Survey has a stock on hand of nearly 9,000,000 topographic maps and it sells over half a million copies annually at the mere nominal cost of paper and printing. This huge stock will soon be doubled, for, in addition to the new maps being constantly published, the demand for all the maps is increasing.

A book could be written about the topographic map. To the person who understands it, it is "a thing of beauty and a joy forever." To the casual observer it appears to be simply a sheet of paper with a great mass of irregular, reddish-brown lines. He can readily see the towns, and the county lines and the rivers and the roads and the bridges, and even the individual farm houses, but he is apt to be bothered by the brown lines and wonder why they cumber what would otherwise be a good map.

These same brown lines, the contour lines, are what proclaim it a topographic map. They show the contours of the hills and the slopes—the topography—and the definition of topography is "the configuration of a land surface" and, as applied to mapping, "the exact and scientific delineation and description in minute detail of any place or region."

Place your pencil at random on any part of the map—on a house, or at a road corner, or a hilltop. In an instant you can determine the altitude of that point. The farmer can tell, without an expensive survey, whether it is practicable to drain a bothersome swamp; he can work out the feasibility of an irrigation project; he can find out the flow of a stream running through his land and then, by calculating the fall of the streams from the map, he can approximate the amount of water-power possibly running to waste.

To the engineer who has larger projects in mind, even to the largest, such as the laying out of a transcontinental railroad, the map is of proportionately greater value, for he can do all his preliminary work on the map spread out before him and save countless thousands of dollars for trial surveys which, when completed usually, serve no other than his own particular purpose.

In the past and at the present time vast sums have been and are being spent on special surveys, the great majority of which can be eliminated when this basic, general-purpose, topographic map is available. Small wonder then that the railroad engineers, the good-roads engineers, the water-power engineers, the drainage engineers, the soil-survey engineers and every other kind of engineer all combined to demand the completion of this mother map.

Geological Survey topographic maps are published in convenient-sized sections, each covering a "quadrangle" of ground, and are bounded by parallels of latitude and meridians of longitude or their subdivisions. The edge of each map matches exactly the edge of the map of the adjoining quadrangle—the contour lines and the political boundary lines

IN THE FROZEN NORTH

In Alaska, which will be covered by the work of the Geological Survey topographic and geologic mapping, dog teams replace the horse packs of the Survey

IN SOUTHERN SWAMPS

This scene, contrasted with the one on the left, will give some idea of the extremes of climate and other conditions for which the topographic surveyor must be prepared

TO THE RESCUE

In the process of making a topographic survey of the Colorado River a boat was lost and swept away in the river's turbulent waters

FORTY-FIVE YEARS AGO

The United States Geologic Survey party in 1880, when the work of making topographic maps of the United States was begun

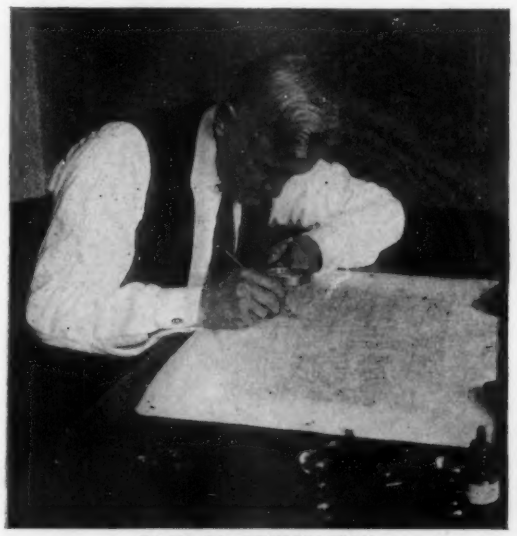
run from one map to the next—so that if all the United States should be mapped on the same scale of say one mile to one inch, which is the general standard, the map sheets could be perfectly joined into one big map, and it would cover about one acre.

The map of the State of New York would be about 27 feet north and south, and, including Long Island, 35 feet east and west. Such a map of even little Vermont would be 13 feet high, while to hang the map of California would require a scaffold nearly 60 feet high. The mapping is actually done, however, on several scales, ranging from approximately one inch on paper representing approximately one, two, or four miles of country. Such maps as that of the capital of the United States and the surrounding region are on a still larger scale, one inch of paper representing one-half mile of country, or to state it the other way around one mile of country being delineated on two inches of paper. This is a very large scale map. If the United States were mapped on this scale, the resulting map would measure about 500 feet from ocean to ocean.

Airplanes to Help in the Work

For certain very special needs the surveying is done on even larger scales than two inches on paper to one mile of country. The bulk of the mapping is, however, on the scale of approximately one mile to one inch, or exactly one inch on paper to 62,500 inches of country. Many of the older maps of the Geological Survey, some of which are among those which must be done over, are on the very small scale of four miles of country to one inch of paper.

The topographic surveying under the Temple Act will take great numbers of the Geological Survey engineers far afield. They will have to visit every square mile of the unsurveyed regions of the United States. They will have to climb many thousands of high mountains to obtain their sights, with a surrounding wild chaos of peaks and gorges; they will have to make their temporary abode in the low places of the country, in the trackless swamps and jungles of the south and the overflow of other regions, and at other times in the desert where there is no water.



BACK TO CIVILIZATION

The topographic engineer, no longer in field garb, is inking in his map

CLIMBING THE "THREE SISTERS"

A triangulation station in Oregon at an altitude of 10,612 feet. The engineer and his assistant are carrying their plane table and telescopic alidade

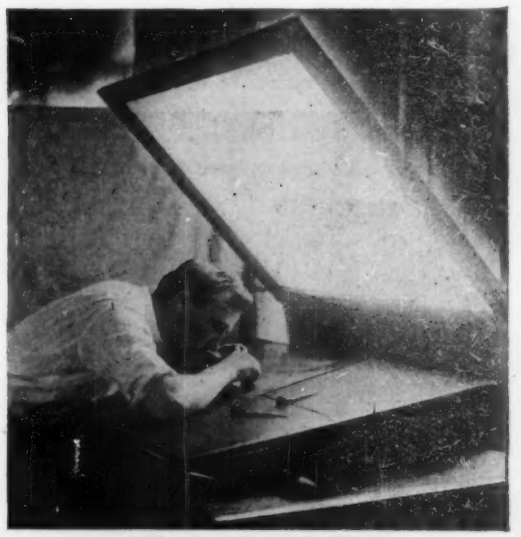
Danger and adventure and hard labor come into all this activity of the Geological Survey, yet it has always been and always will be, until the last square mile is surveyed, simply all in the day's work.

Much of the surveying will be done with the aid of the airplane, which is coming into constantly greater use in mapping. The planes fly at an altitude of 12,000 feet and make photographs which are later enlarged and adjusted, at a great saving of field work. Much of the map information, too, is of a confidential nature, for the eyes of the War Department only, since the Army has adopted the Geological Survey's standard topographic map as its tactical map for national defense.

Map to Stand Test of Time

These Geological Survey topographic engineers are an enthusiastic lot of men, combining intense practicality with high scientific ideals. Each chief of a party goes out in the spring to his specified area determined to produce a map that will show every delineation of topography and that will stand the test of all time. When he returns in the fall, driven in by the snows, he brings his valued piece of map with him, completed, made in the field, as he has seen the country and depicted it, a finished map, except for the inking in of his exact sketching, the lettering of the names of the towns, the rivers and other features. This is the prime difference between the topographic map and any other kind of map.

The government topographic map is made in the field by the engineer; other maps are made or compiled at a desk or table by a draftsman. The compiled map, printed in many colors, may be beautiful to look upon, but it may be inaccurate in a hundred ways.



ONE OF THE LAST STEPS

An engraver transferring the topographic map of the engineer to copper plates

THE THREE TYPES OF FINGERPRINTS

From left to right, they are arches, which constitute five percent of all ridge patterns in any collection of impressions, loops which constitute approximately sixty percent, and whorls which make up the remaining thirty-five percent

Everybody Should Be Fingerprinted

A System of Universal Registration Would Benefit Especially Those Who Were Recorded

By Richard E. Enright

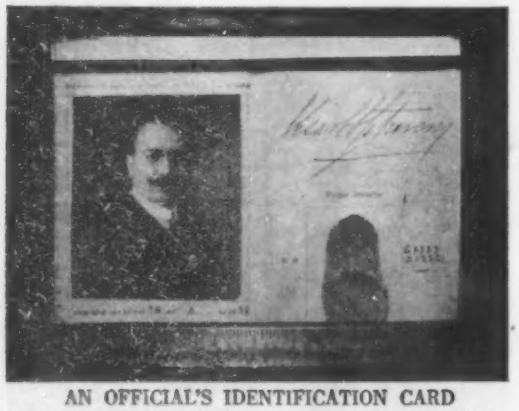
Police Commissioner of New York City

TWO YEARS ago two bank messengers, one of them a former Brooklyn policeman, were returning from the bank with a bag containing $43,000 in currency. As they began to mount the elevated railroad stairs a high-powered automobile glided up to the curb, five men slipped out and followed the messengers. The car remained stationary with its engine running.

Without a word of warning, without even a demand to throw up their hands, the two were shot dead. The five bandits grabbed the bag, dashed down the stairs and into the car and disappeared.

Twenty-four hours later the police found a car they thought might possibly be connected with the murder. On the windshield were the faint prints of a man's fingers. Here was a clue. The marks coincided with those of a criminal whose record was in police headquarters. Four days later this man and two of his confederates were arrested in Cleveland. About half of the loot was recovered. Three of the five men have since been electrocuted. One awaits a retrial. The trial of the fifth is pending in Italy.

Had not the fingerprints of one of the criminals been in the files of the criminal identification bureau those five men might still be at large, a menace to the community.



AN OFFICIAL'S IDENTIFICATION CARD

Carried by Dr. Cesar Etcheverry, Commissioner of Identification in Buenos Aires, where everybody has a little book containing his fingerprint, signature, photograph and general description

It is not alone in cases of crime, however, that fingerprint records are useful to the police. They are of great value in other kinds of problems the police are called upon to solve. Missing persons could be traced more easily if we had a record of their fingerprints. Every once in a while we come across a person suffering from asphasia or amnesia with no clue to his identity. If that person had been fingerprinted we could learn who he was without difficulty. If all infants at birth were fingerprinted our problem would be solved in the case of foundlings. Doctors could make the fingerprint or a footprint a part of their record in reporting the birth to the Bureau of Vital Statistics.

Public Prejudice Must Be Overcome

While fingerprints are of inestimable value to the law-enforcement organizations, it is unfortunate that everybody associates them so exclusively with the police. As a matter of fact, fingerprints could be used far more effectively in commercial life than in criminal matters. Take the case of a legacy, for example. A man would find it necessary to establish his identity in order to inherit a certain piece of property. It could be done easily if there were complete fingerprint records.

Or take a case involving the life insurance companies. A man is found dead. The question arises as to whether or not he was the man who held an insurance policy with a certain company. His heirs say that he was. The company says that he was not. If he had placed his fingerprints on the policy at the time it was issued to him there could be no question as to his identity.

One of the big advantages to business in having fingerprint records is that it would reduce the tremendous losses through crime. The toll that the crooks of this country exact from business has been variously estimated at from $1,000,000,000 to $3,000,000,000 a year. I am inclined to believe the lower figure is the more nearly correct. But even this sum is approximately the amount of money it cost the Government to carry on for a year up to as late as 1910. If we had adequate fingerprint records readily available, even if we had assembled in one central place only those fingerprints which already have been made by the police, the toll of life, property and injuries could be reduced from twenty-five to fifty percent.

That is what we could accomplish if we had only the fingerprints of all our known criminals assembled in one centrally located, readily accessible place. Imagine what we could do if we had the prints of every man, woman and child in the country, the good citizens as well as the bad ones, the innocent who need protection, as well as the vicious ones.

I strongly recommend the inauguration of a system of universal fingerprinting. This should have nothing to do with the police. The records should be kept in some centrally located place, perhaps under the jurisdiction of the Department of the Interior at Washington. The police, of course, might have access to it in cases of necessity, but should have no voice in its operation and control.

There really is no sound objection to universal

THE SOLE CLUE TO THE MURDER

These prints on the windshield of an automobile led to the arrest and conviction of four men and the execution of three of them in one of New York's most sensational and heinous crimes

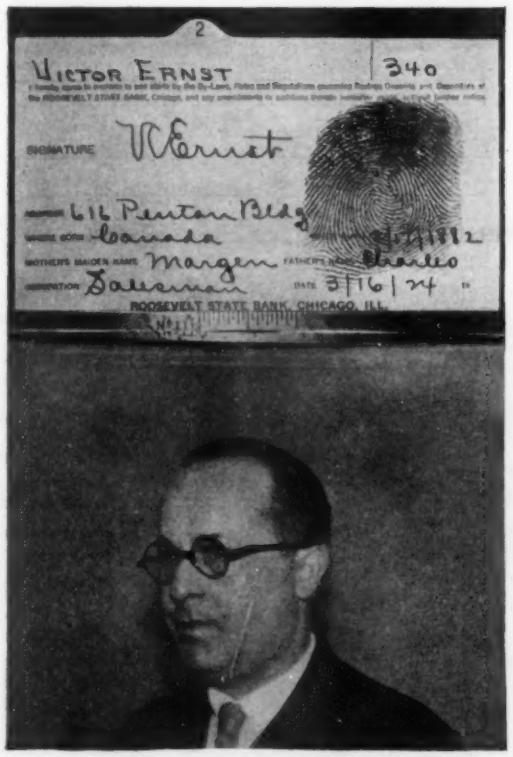
fingerprinting. The only objection which has yet arisen appears to be one of prejudice. People in this country are jealous of their personal rights and they resent fingerprinting as an invasion of their privacy. I wonder if back of this in the mind of each individual objector there may not be the fear that possibly some day he, too, may become a criminal?

In other countries universal fingerprinting has been a pronounced success. A very remarkable development along this line has taken place in Argentina and in several other countries of South America. In Buenos Aires voluntary but universal fingerprinting is the practice. Every resident there, whether he is a citizen or an alien, is provided with a little book containing means to identify him. This includes his physical characteristics, his photograph, his signature and his fingerprint. It is significant that the persons who are most enthusiastic over this system are the Americans who live in the country.

An Advantage to Innocent Citizens

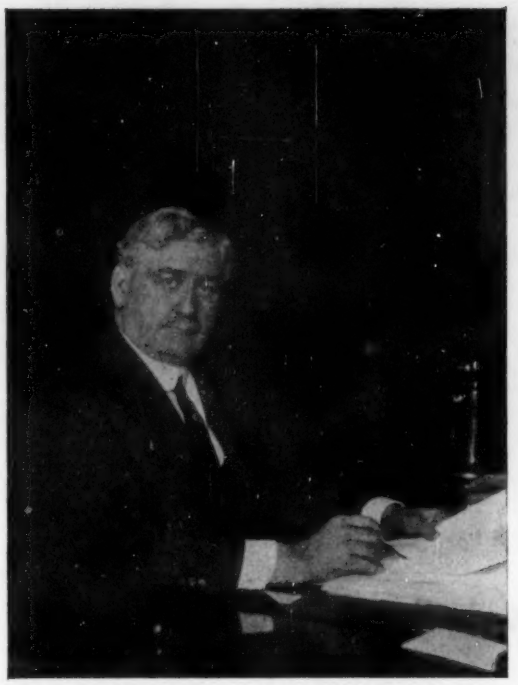
At the International Police Conference held in New York City last May General Alfredo Horton Fernandez, Police Commissioner, and Cesar E. Etcheverry, Commissioner of Identification, both of Buenos Aires, described the system in effect there and urged its adoption by the United States. They pointed out that the aim is not to identify the whole of the population on the supposition that all are bad. On the contrary the object is to distinguish more easily the law-abiding citizens to whom the police are obliged to render help.

As a matter of fact, records of fingerprints would be a distinct advantage to innocent citizens. They might often amount to a guarantee of safety. Suppose a man were unjustly accused of a crime. He could prove his innocence by means of his fingerprints. This very thing has happened. I recall the case of a fingerprint expert in the Department of Correction being called to New Jersey some time ago to identify a man accused of a crime in Pennsylvania. The suspect protested he could not have committed it because he was imprisoned on the day of the crime. There was strong evidence against



SUGGESTED FOR ALL OF US

The proposed handy certificate in notebook form carries a signature, "pedigree," thumbprint and photograph. It is a strictly commercial document and has nothing to do with police affairs



NEW YORK CITY'S POLICE COMMISSIONER

Richard E. Enright advocates fingerprinting for everybody as a protection for innocent citizens. He predicts it will be popular when it is understood

him, but in spite of this his fingerprints proved the truth of his statements and led to the uncovering of false testimony being used against him.

Such a system provides a first-class identification for the man who is privileged to carry one of the certificates. It is invaluable to him when he is traveling outside his own city. It is positive identification at the post office, at the express office and at the polls when he goes to register. It is identification when he is apprehended by a police officer. The policeman can serve such a man with a summons instead of arresting him or he can warn him. This often is as effective as an arrest.

The certificate or card of identification while of great use to any citizen engaged in lawful pursuits is no protection to the citizen if he happens to go wrong. It neither excuses him nor mitigates the force of the law.

Fingerprinting Aliens Important

Here is one example of the manner in which the system of universal identification works in South America. Employers, when a man comes seeking employment, say,

"Well, have you an identification card?"

If he says he has not they reply,

"How do we know you are the man you say you are? Get a card and then come back."

If the man is a crook he does not get the card and he does not come back.

In New York City we have nearly 700,000 fingerprints—one of the largest collections in the world. Here is what it includes:

- Known criminals who have been in contact with the New York police
- Out-of-town criminals
- Persons convicted of minor offenses in the magistrates' courts
- Persons who have been under the supervision of the Department of Correction
- Persons applying for hack drivers' or chauffeurs' licenses
- Persons applying for pistol permits
- Members of the Police Reserve
- Candidates for the Police and Fire Departments and for other positions having to do with the safety of persons and property
- Members of the New York and Brooklyn postal services.

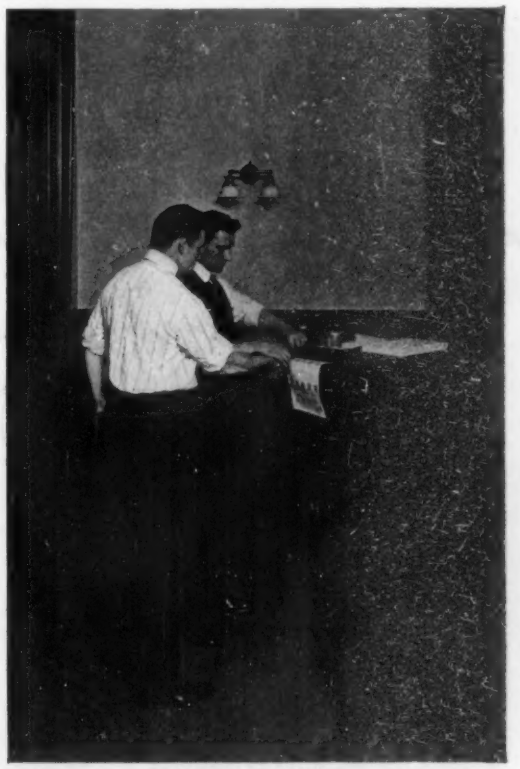
In addition to these we should have for police purposes the fingerprints of all aliens. When an alien commits a crime it is hard to find him, for he is not a member, as a rule, of any club or political or social organization. In other words, the usual means of identification is missing and in such cases fingerprinting would be doubly valuable.

The day when we will have universal fingerprinting probably is a distant one, although we are headed for it. President Coolidge has recommended to Congress the creation of a national police bureau. Senator Moses has introduced a bill in the Senate to establish such a bureau. The most important feature of such an institution would be the collection of fingerprints from all parts of the country. I have every reason to believe the bill will pass.

Registration Need Not be Obligatory

Captain John A. Golden, head of the Bureau of Criminal Identification in the New York Police Department, and one of the best informed men on fingerprints in the United States, suggests that a start toward universal printing be made by having prints of school children taken at the age of twelve years. He suggests this age, because some children do not attend beyond that period and because at that age a mature print is shown. At a lesser age the ridges on the fingers are not developed sufficiently to show fully. At the end of twenty-five years, he estimates, the fingerprints of practically everybody in the United States would be on record. The collection would include, of course, the fingerprints of all immigrants.

Perhaps at the present time a law, making universal fingerprinting compulsory, would not be feasible. I do not advocate such a law, for I do not believe it would be necessary. Let a central bureau be established where all fingerprints could be kept and let the public be made fully aware of the advantages of being on record in such a bureau, and it will not be long before it is just as inclusive as it would be if fingerprinting were obligatory. When such a system becomes operative the administration of many of our affairs will be easier and more efficient to the benefit of all of us.



TAKING A PRINT

Ink is spread on a block with a roller; upon this the fingers are placed one at a time and then rolled gently but firmly on a piece of paper to give a lasting and irrefutable means of identification

F. M. Delano

F. M. Delano

LEFT: *Senile, feeble and decrepit: A twelve-year-old ram before being grafted.* RIGHT: *The same old ram almost six years later, with his mate and third lamb*

Can Old Age Be Deferred?

An Interview with Dr. Serge Voronoff, the Famous Authority on the Possibilities of Gland Transplantation

THERE is a "Fountain of Eternal Youth." It lies in your glands. Through its life-giving flow old age may be postponed, if not avoided. Even death, save by accident, may become unknown, if the daring experiments of Dr. Serge Voronoff, brilliant French surgeon, continue to produce results such as have startled the world.

"My first determination to undertake this work," said Dr. Voronoff, "came from the realization of the dominant role of the endocrine glands in the human organism. Up to forty or fifty years ago physicians admitted that the energy which caused our organs to perform their various functions was an inherent one. They took it more or less for granted, however, that the secret of this energy never would be found—that the inherent energy that made the heart beat, for example, was a God-given motive power not to be tampered with."

Brain Not the Controlling Center of Life

These theories, Dr. Voronoff pointed out, were first shattered by the remarkable experiments and discoveries of Claude Bernard on the endocrinal value of the liver. Close on the heels of Bernard's research came the work of Brown-Sequard. For the first time the brain was found to be not the controlling center of life, but a peculiar combination of gray flesh, capable of producing thought only when properly controlled by the chemical action of the liquid from the thyroid glands.

With improper functioning of this gland a young man became mentally old and feeble, useless to himself and to society. His physical condition, too, formerly strong and healthy, became weak and unsteady. Infants with congenital atrophy of the thyroid always show, both mentally and physically, the effects of such a condition, being puny in every way. Animals deprived of their thyroid glands soon after birth, according to experiments, are altogether outgrown by others of the same age within a period of eight to ten months.

On the other hand, it has been proved by experiment that a hypertrophy, or over-development, of the thyroid gland will cause such an over-excitation of the mental processes as to amount in some cases almost to insanity. Hypertrophy of other glands, such as the pituitary glands, which are situated at the base of the brain and which control the growth of the living cells, will cause occasional freak giants.

"Even the smallest glands sometimes play the largest roles," observed Dr. Voronoff. "Take away from an animal the four little para-thyroids, located beside the thyroid, and the effect is absolutely disastrous. The nervous system undergoes a terrific over-excitation, the muscles contract violently, and the subject dies in violent convulsions within a short time. The suprarenal glands, if removed, would cause death by a sort of strange lethargy, known as Addison's disease.

"But," continued the great surgeon, "it is, after all, the functions of the reproductive gland that have taken my entire attention since 1910.

"This remarkable and all important center, which has been regarded until recently as merely a mechanism for the prolongation of the life of the race on earth, plays one of the greatest and most important parts in our everyday normal physical existence."

Dr. Voronoff pointed to the many examples of men and animals deprived of these glands. Their flesh becomes soft and flabby. Their mental energy wanes; their whole bodies sag and drop out of proper form; their blood is thin and poor. From latest observations it is entirely probable, says the doctor, that the work of the other glands may be distinctly affected and reduced by the loss of the secretions of these central glands.

F. M. Delano

DR. SERGE VORONOFF
Well-known exponent of rejuvenation by gland-grafting

As one remarkable example of the opposite effects caused by the over-development of the gland in question, Doctor Voronoff cited the case of a boy nine years old who was suffering from a hypertrophy of one genital gland. He had a full black beard and mustache, remarkably hairy arms and legs and the stockily settled appearance of a mature, though small man. When the extra growth was removed, the boy lost, within six months, all of his beard, except his mustache, as well as the heavy hair on his arms and legs. His mental condition, which previously had been far above normal for his age, dropped back nearly to that of other boys of his own years.

Results Not Immediate

"Here," said Doctor Voronoff, "was a remarkable demonstration that the glands play a part of primary importance in our mental and physical development. This does not mean that it is always the amount of glandular tissue present which can be called a hypertrophy, but it is evident from present knowledge of the construction of the glandular system that an over-growth makes itself felt upon the entire human system."

First attempts to change the conditions of men from this source were made, according to Dr. Voronoff, in 1869, when Brown-Sequard endeavored to inject into the glandular tissue of a man secretions from the glands of an animal. The experiment was successful at first, but the effects did not last for any length of time.

The experiment proved one thing, however—which is known also from other investigations—that the glandular secretions of both man and animal are chemically identical. The reactions observed are brought about, not through the energy of the fluid, but rather through the quality of the organism upon which the fluid acts. The thyroid gland of a man grafted into a sheep could not produce the mental activity of the man in the lower animal, nor

would the thyroid gland of the sheep produce in the man that stupidity for which sheep are noted.

"The idea of the grafting of glands is not entirely novel, for as far back as 1767, an attempt was made by Hunter to change the glands of chickens," said Dr. Voronoff. "What is new? It is the practical realization of this grafting which is new, relatively speaking. In the past all efforts to graft glands in the higher animals and in man were failures, giving only a few weeks successful stimulation, at most, and then being reabsorbed into the dead tissue. The explanation of the failure is simple. These glands had merely been inserted under the skin or in the muscles, where they had been left to take root and grow, with no aid from the surgeons.

"In my own work I found that such a failure always followed such a method. The new glands never lasted long; they apparently expended only the slight residue of fluid which they contained, and then they gradually died. At last I realized that these grafted glands were not being properly fed by the new system into which they had been incorporated; thus it was impossible for them to produce any new fluid. It is only since 1917, that I have been able to realize a permanent effect."

The most practical manner of operation in these transfers, is to cut the gland itself into four parts, placing two of the "slices" in each of the "pockets" where in time the two will grow into one active unit. The results are not immediate, as the glands must have time to begin their normal functioning. In two or three months, he says, men who have had these grafts have come to him and reported that their first noticeable effect is that of a greatly improved memory. They are mentally stimulated; their color begins to come back into their cheeks; their eyes brighten; their muscles become elastic.

Startling Results With Animals

Another and more recent field of this research, which rivals in interest the grafting of glands in human beings, is the work Dr. Voronoff has been doing with animals. His chief activity along these lines has been the improvement of sheep, although he has operated upon horses, cattle, goats, pigs and other domestic stock. His experiments, which have been carefully recorded, reveal startling results.

In Algeria, for example, the French government owns a flock of about 3,000 sheep, whose wool, partly because of the warmer climate, but still more because of the elision of the germinal gland, was becoming less abundant. With this flock Dr. Voronoff grafted an extra gland into each of the young rams. The result has been an extra heavy coat of wool, an average increase of one pound per sheep being attained.

An interesting example of one of the doctor's earlier efforts to increase wool or hair production

F. M. Delano

AN OUTSTANDING EXAMPLE

The grafted kid on the right is twice as large as his ungrafted twin

is provided by the case of a young goat which was grafted at the age of six weeks. Another kid of the same age was left normal. The grafted animal increased in size far more rapidly than did the normal one until he was nearly twice the size of the latter. His hair, instead of remaining the fairly short length of the common goat, grew to nearly the length of the hair of an angora.

The doctor pointed to the photographs of three lambs upon which he had worked. The youngest, aged three months, he grafted with an extra gland. At the time the animal weighed about thirty-six pounds. The second animal, four months old and weighing forty-six pounds, he left normal, as a "witness." From the third lamb, five months old and weighing sixty pounds, he removed the germinal glands. Ten months later the youngest and smallest lamb had gained thirty-six pounds, the normal, twenty-six pounds and the third, only about nine pounds. When the animals were clipped it was found that the wool coat of the grafted animal weighed almost two and three-quarter pounds more than that of the third animal and was just a few grams short of the weight of the second animal, which was a month older than he. The length of the wool of the grafted animal, was one centimeter longer than that of the "witness."

One of Dr. Voronoff's most striking experiments was with an old ram. Rams generally live to the age of twelve or fourteen years. With considerable difficulty the doctor found a twelve-year-old ram so feeble that he could neither hold up his head nor walk without staggering.

"I grafted into this animal," said the scientist, "a gland taken from a ram two years old. In three months time that old wreck of a beast became aggressive, heavy set, active and even splendid to look at. And eight months after this graft a lamb was borne by his mate.

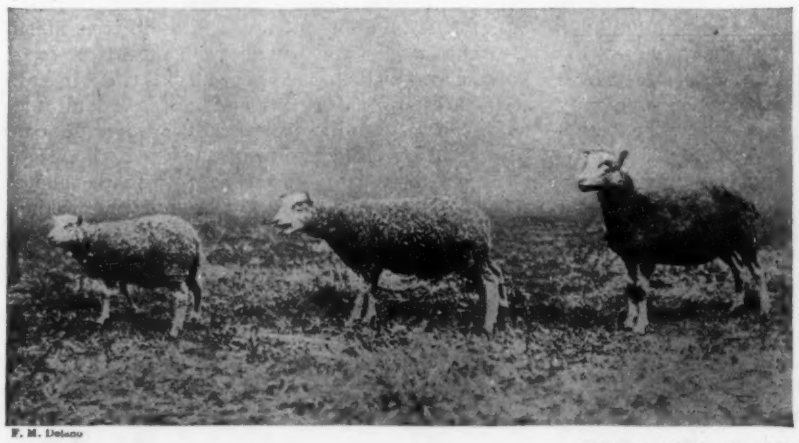
"To avoid any imputation of 'autosuggestion' I removed the gland from this animal again. All my operations on animals, by the way, are done under a powerful, local anaesthetic so that they suffer no pain. Within three months this animal again became the old feeble tottering ram we had found at first. Again I provided him with an extra gland and again he regained his strength, vigor and aggressiveness. Today, six years after this animal by all known laws of sheep raising should have been dead, he remains alive, energetic and useful. He continues to produce a splendid coat of wool each year, in spite of the fact that he has passed by one-quarter the normal length of a ram's life.

"Consider the economic significance of gland grafting with sheep alone. Already we have gone far enough with our experiments to demonstrate that by continual grafting for several generations it is entirely possible to establish a superior race of animals with a heavier coat of wool, and so bring about a very great reduetion in the price of woolen clothing." Bearing in mind the fact that in France, Algeria, Morocco, America, Canada, Argentina, Australia, and elsewhere, upwards of 150,000,000 of sheep are raised annually, the economic possibilities are indeed vast.

Shall We Live to be 125?

Just what may be done with the human race Dr. Voronoff is not yet prepared to predict with assurance. But his researches hint at startling developments. He has grafted many men; some of them are showing signs of reabsorption, but most of them still are in the prime of health and vigor. Diseases to which old and weakened frames succumb easily are shaken off by these young-old men invigorated by new glands. The various organs function as they should. The entire system is rejuvenated and strengthened.

"We must wait," says Dr. Voronoff. "If we consider one year of a ram's life equivalent to six years of a man's, then we may estimate that by grafting we can add thirty or forty years to a human life. We cannot tell yet just what results we will achieve, for we have been grafting glands successfully only for the last five years. When we have lengthened a man's age to ninety perhaps we will have done something. When a man will have lived to be one hundred and ten we probably will have accomplished something interesting. When he will have lived to be one hundred and twenty-five, we will at last have found the path toward the abolition of old age."



F. M. Delano

F. M. Delano

THREE SUBJECTS OF DR. VORONOFF'S TESTS

LEFT: *Three young lambs photographed before the smallest was grafted. The second ram was left normal. From the third, the germinal glands were removed.* RIGHT: *The same lambs ten months later, photographed in reverse order*

Our Point of View

The Will to Peace

THE Scientific American believes in armies; and it believes in navies. They are an indispensable necessity for the policing of the world. Having said that, we do not hesitate to state that it is naval and military men, with a few notable exceptions, who preach the doctrine of inherent and ineradicable human antagonism, and laugh at the idea that the way to peace lies in amicable treaties and a reduction of the post-war armies of the world. The latest and most deplorable evidence of this was shown the other day before the Institute of Politics, at Williamstown, when General Maurice, of the British Army, expressed his belief that no treaty agreement would suffice to prohibit the manufacture and use of poison gases, giving as his reason that these gases, unlike big battleships, could be manufactured in secret—all treaties to the contrary. General Maurice would seem to believe that, in the most literal sense, "all men are liars," and that any one of the nations of the earth, in an emergency, would, like Germany, speak contemptuously of a signed treaty as a "scrap of paper." Though the General represents the attitude of most military men, he is running in the very teeth of public opinion outside of the Army. The outburst of indignation at the scrap of paper incident, and later, on the first use of poison gas, was widespread, deep seated and very real. That feeling has grown steadily since the war. We believe that, if a referendum were taken among the civilized nations of the world, excluding the naval and military vote, it would be found that mankind, including Germany, is against this form of warfare, and still regards its pledged word as sacred.

If, as some would have us believe, thoughts are things; if peace is a state of mind; the starting point in all effort to pacify the world is to strengthen in men's minds that will to peace, which has been born of the disillusionment and wreckage of the late war.

More Earthquake Lessons

WE have headed this little talk "More Earthquake Lessons." On second thought, it would, perhaps, be more appropriate to write "The Same Earthquake Lessons"—for the recent Santa Barbara shock has merely reiterated the truths which were taught in the stupendous Japanese earthquake. The fact that some Santa Barbara buildings passed through the tremor unscathed and that others were shaken to pieces is not to be explained by any local intensity of the shock, but rather by the fact that the architects and builders of the wrecked structures had apparently made no provision whatever for resistance to earthquake shock. The architect of a building that is to be erected in a location where seismic disturbances never come has merely to consider gravity and the force of the wind, both of which express themselves as pressure; but in earthquake shock there is a dynamic lateral movement of the earth which has to be transmitted as a bending stress throughout the full height of the building above. Hence, earthquake construction imperatively demands that the buildings be well tied together; that the floor beams at each floor be anchored to the outside walls; and that the outside walls themselves should be of sufficient strength to carry, without rupture, the lateral sheering stresses which are developed throughout their whole height. It was failure to incorporate these features that caused the outside walls of one building to break entirely away. In short, for earthquake or tornado effects, the construction should be what an engineer would call "coherent."

Dr. Hornaday's Sportsmanship

WE have seldom read so uncalled-for, unjust and unsportsmanlike an attack as that made by Dr. W. T. Hornaday upon the American Game Protective Association and its highly regarded president, Mr. John B. Burnham, and published in the *New York Times* of August 12th. We do not know the exact value which Dr. Hornaday places on his own personal reputation for good manners; but we feel, and all of his friends will feel, that before sending his amazing statement to the press, he should at least have given some thought to the position of dignity which he holds as Director of the New York Zoological Gardens.

We find it difficult to determine in our own mind just exactly what is the matter with the Doctor. So far as we can get at the truth, it would seem that he has been thrown thus sadly out of joint by the fact that he was recently out-voted in a meeting of an Advisory Board of the United States Biological Survey; and that the only way he could express his chagrin was by turning loose upon some of the most prominent and respected citizens of New York and Washington with a personal abuse which would do credit to a disappointed ward politician.

Reduced to its essentials, Dr. Hornaday's charges practically amount to this: He would have us believe that the opposition to his proposed further reduction of the bag—that is, the amount of game a hunter may bring home at the end of a day's sport—is due to the influence of the gun makers. Now, the amount of game that one may kill in a day was determined by men of the highest professional attainments in biology, (particularly in ornithology) who are possessed of an intimate knowledge of game conditions; and their findings were based upon a thorough survey of the whole field. Behind that movement are such men as Dr. E. W. Nelson, president of the United States Bureau of Biological Survey, Mr. J. B. Burnham, chairman of the American Game Protective Association, and Mr. George D. Pratt, former New York State Conservation Commissioner. Nevertheless, Dr. Hornaday attributes their opposition to him to the fact that they are in league with the arms and ammunition manufacturers who, we are left to infer, are working in the matter purely for an increase of dividends.

His friends, among whom we think we may include ourselves, are asking what in the world has happened to the good Doctor. In earlier days he had no small reputation as a good sportsman; and he surely has not forgotten that the man is reckoned a poor sportsman who, when he is beaten, turns around looking for someone to bite.

The Scientific American has no apologies to make for giving space to this unhappy episode. As our readers are well aware, we have always been strong advocates of conservation; of a reasonable limitation of the bag, and of the provision of ample feeding grounds for the great flocks of birds that sweep north and south in the migratory season.

Light at Last on Cancer

It really begins to look as if the long sought solution to the problem of what causes cancer had at last been reached. Two Englishmen—Dr. W. E. Gye, a physician, and Mr. J. E. Barnard, an expert microscopist—working together, have just announced their discovery that cancer is caused by two separate and quite different elements which must act together—a virus and what Dr. Gye calls the "specific factor." The virus is a living, parasitic organism which would be popularly called a germ; while the specific or accessory factor is a chemical substance produced by the body cells themselves—presumably in the course of chronic irritation.

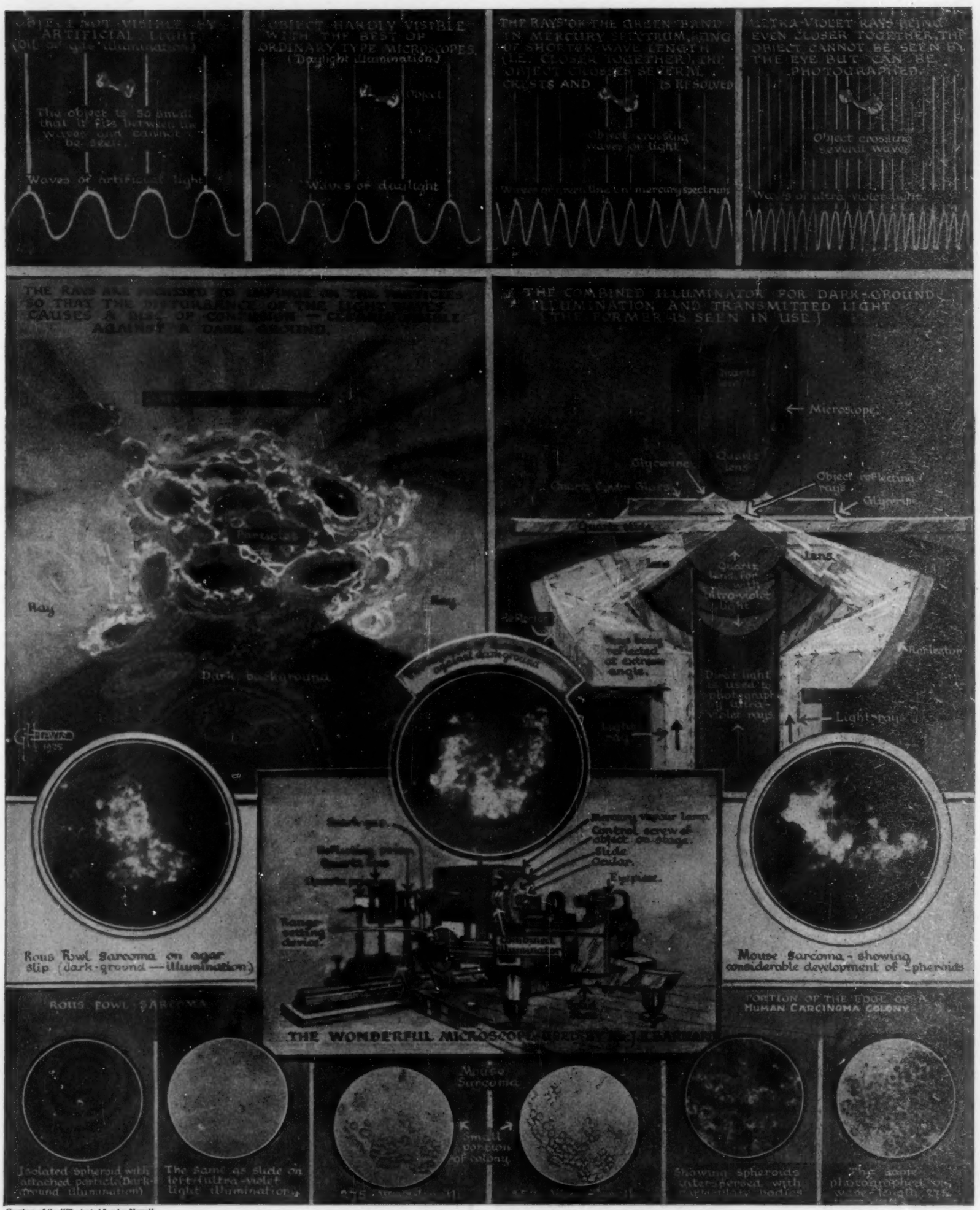
So favorably has the discovery impressed *The Lancet* (foremost British medical journal) that this cautious and conservative organ, in publishing a full account of Dr. Gye's and Mr. Barnard's work in the issue of July 18, states that it "marks an event in the history of medicine," adding that *"the existence of a living cancer virus would appear to be established."* Coming from so dependable a source as *The Lancet,* this degree of endorsement is significant.

What must now eventuate before the cure is found, is: first, a more complete investigation of the cause of cancer; second, the duplication of the experiments by other scientists, in order to verify them. Next, the acceptance of the results by medical science; finally, the drive for a *cure.*

Labor-saving in the Metric System

Is it not an anomaly that a nation which prides itself on its labor-saving achievements should refuse to make use of the metric system—one of the greatest labor-saving devices of this or any other age? Mr. Aubrey Drury, Director of the All-America Standards Council, in an effort to determine the effect of the metric units of weights and measures in increasing the external trade of the United States, recently addressed an inquiry to American consular officers throughout the world. Out of over one hundred replies, not one reported adversely to the metric system. Mr. Homer Brett, Consul at Bahia, puts the matter very forcibly when he says: "Surely when such a magnificent instrument is ready to our hands the nation that is famous for its practice of scrapping even good machinery when better becomes available should not go on with three different kinds of grains, ounces and pounds, with short tons, long tons, cargo tons and measurement tons, with inches, feet, yards, rods, furlongs and miles, and all the unsystematic and illogical mess comprised in our present weights and measures."

We are thoroughly in sympathy with the above statement. That the two great English-speaking nations, who are accustomed to pride themselves upon their initiative and adaptability, should hold on so tenaciously to an outworn and cumbersome system of weights and measures is one of those baffling anomalies for which it is difficult to find a reasonable explanation. It is not sufficient to point to the temporary inconvenience and expense involved in making the change; for these sink out of sight when placed in the scales against the great efficiency and economy of the metric system and against the fact that it constitutes a bond of international unity.


OBJECT NOT VISIBLE BY ARTIFICIAL LIGHT
(Oil or gas illumination)
The object is so small that it fits between the waves and cannot be seen.
Waves of artificial light
OBJECT HARDLY VISIBLE WITH THE BEST OF ORDINARY TYPE MICROSCOPES
(Daylight illumination)
Object
Waves of daylight
THE RAYS OF THE GREEN BAND IN MERCURY SPECTRUM, BEING OF SHORTER WAVE LENGTH (I.E. CLOSER TOGETHER) THE OBJECT CLOSER SEVERAL CRESTS AND IS RESOLVED
Object crossing waves of light
Waves of green line in mercury spectrum
ULTRA-VIOLET RAYS BEING EVEN CLOSER TOGETHER, THE OBJECT CANNOT BE SEEN BY THE EYE BUT CAN BE PHOTOGRAPHED
Object crossing several waves
Waves of ultra-violet light
THE RAYS ARE FOCUSSED TO IMPINGE ON THE PARTICLES SO THAT THE DISTURBANCE OF THE LIGHT WAVES CAUSES A RING OF CONFUSION — CLEARLY VISIBLE AGAINST A DARK GROUND.
Ray
Ray
Dark background
THE COMBINED ILLUMINATOR FOR DARK-GROUND ILLUMINATION AND TRANSMITTED LIGHT (THE FORMER IS SEEN IN USE)
← Microscope
Glycerine
Quartz lens
Object reflecting rays
Glycerine
Lens
Lens
Rays being reflected at extreme angle.
Direct light used to photograph by ultra-violet rays
Reflection
Light rays
Rous Fowl Sarcoma on agar slip (dark-ground — illumination)
Mouse Sarcoma - showing considerable development of spheroids
Mercury vapour lamp.
Control screw of object on stage.
Slide
Condenser
Eyepiece.
Range-setting device.
Condenser Illumination
THE WONDERFUL MICROSCOPE
ROUS FOWL SARCOMA
PORTION OF THE EDGE OF A HUMAN CARCINOMA COLONY
Isolated spheroid with attached particle (dark-ground illumination)
The same as slide on left (ultra-violet light illumination)
Mouse Sarcoma
Small portion of colony
Showing spheroids under-developed, with intermediate bodies
The same photographed by ultra-violet light

Courtesy of the "Illustrated London News"

THE BARNARD ULTRA-MICROSCOPE AND PHOTO-MICROGRAPHS OF THE CANCER GERM

The best of ordinary microscopes fail to reveal the cancer germ—which is only 1/250,000 of an inch in diameter—and Mr. Barnard's special technique is necessary for their detection. The cancer germ does not reproduce by dividing like the bacteria, but little spheroids appear on their sides, and these soon move away to repeat the process. *(See box on facing page)*

Cracking the Lead Atom

How the Romantic Quest of the Alchemist—the Transmutation of One Metal Into Another—Is Being Scientifically Pursued by Two Dutch Savants

By Prof. Dr. A. Smits and Dr. A. Karssen

Of the Laboratory for General and Inorganic Chemistry of the University of Amsterdam

ACCORDING to the request of the editor of the Scientific American we will give here a brief description of the experiments which we are carrying out in order to examine whether or not lead can be transformed into another element; in a subsequent article we will communicate our results.

One of us [1] has already mentioned the considerations by which it seemed to him possible to realize transformations of elements. For several years he intended to study different metals in a vacuum lamp, in the hope that on increasing the current-density, the atom would be cracked.

However, as he was steadily occupied by other investigations, the experiments were delayed. A year ago last July another experimenter, Professor Miethe of Berlin, communicated to the scientific world the statement that he had realized the transformation of mercury into gold, using the mercury lamp of Jaenicke. This announcement renewed the present author's previous interest in the transmutation problem, and he therefore resolved to return to his proposed experiments, and began to study the metal lead. Since then, this study has been continued by both of us.

Peculiar difficulties arise in studying this metal, because lead fuses at 327 degrees, Centigrade (621 degrees, Fahrenheit), and also because lead, if solidified in a quartz vessel, breaks this vessel if heated again. Notwithstanding this fact, we succeeded in constructing a satisfactory lead quartz lamp which is shown in Figure 1.

The two legs A and B of this quartz lamp end in two narrow tubes in which two steel electrodes are cemented with sealing wax. Around these cemented ends, two little copper water coolers, G and H, are placed in order to prevent the wax from fusing.

[1] Smits, *Nature*, *114*, 609 (1924).

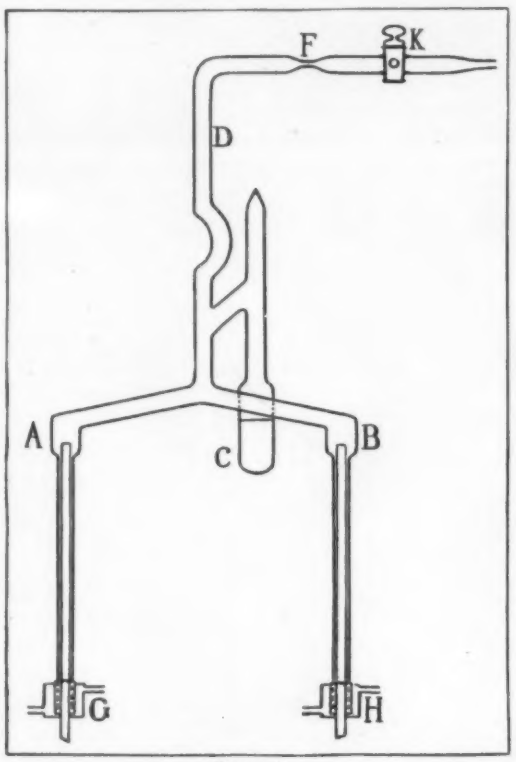


FIGURE 1

First the purified molten lead is poured into the storage chamber C. Then the open upper end of this chamber is sealed off. An electrical furnace around C, but omitted from this diagram, keeps the lead in molten form. The bent tube D contains a capillary F and ends in a cock K.

The free end of the cock is connected with two U-tubes placed in liquid air and the other end is connected with the mercury diffusion pump.

When a high vacuum is reached, the vessel C, containing the purest lead of Kahlbaum, is heated to redness, with the result that all oxide is dissociated from it, and the metal, freed from all gases, has a surface as smooth and as brilliant as pure mercury. After closing the cock K and breaking the connection of the pump with the lamp, the apparatus is inclined and the liquid lead is poured into the two legs of the lamp.

Now the lead in the two legs is once more heated to redness with Bunsen burners, in order to drive out the gases from the steel electrodes. Many bubbles now escape and the apparatus is evacuated once more. After that the lamp is ready and can be used in the same manner as the mercury lamp.

Figure 2 shows this lamp burning after having already burned forty-four hours.

This lamp, like the vacuum-mercury lamp, burns in a vacuum at relatively low voltage. In our experiments the voltage was ± 30 volts and the strength of the current was ± 20 amperes at an arc length of eight centimeters (about 3⅛ inches).

As bismuth is also an element which is to be considered here, and as the system lead-bismuth has a eutectic point at about 120 degrees, Centigrade (248 degrees, Fahrenheit), it was of interest to try this eutectic composition as well. We found that this alloy can be used in exactly the same way. It is evident that at the end of each experiment the liquid must be poured again into the store-vessel C, which is continuously heated to 350 degrees, Centigrade (662 degrees, Fahrenheit), by the little electric furnace which surrounds it.

Because a voltage of ± 30 volts is relatively low, we next tried to get a higher voltage, using a lamp of another type of construction. First we built a

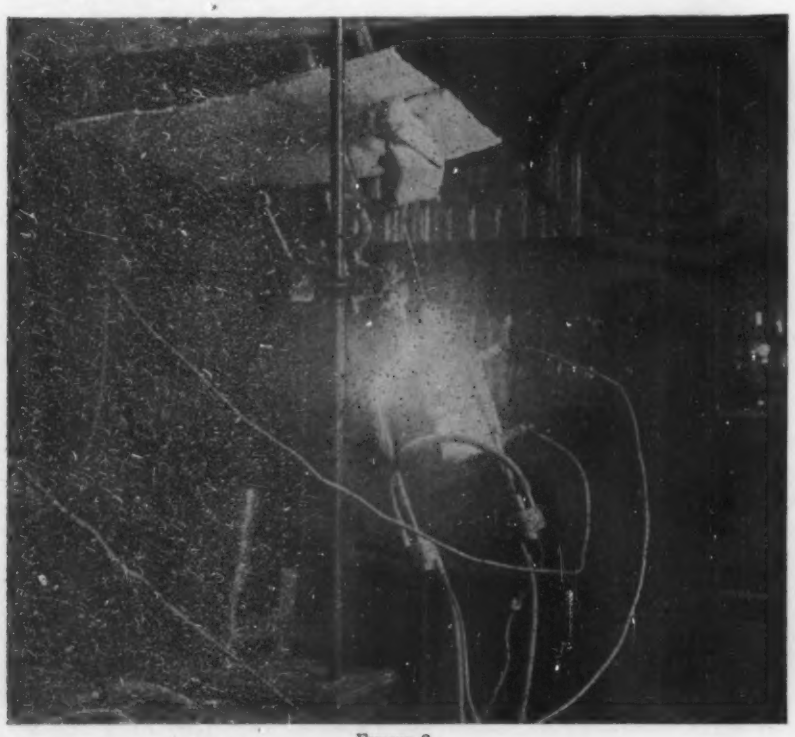


FIGURE 2

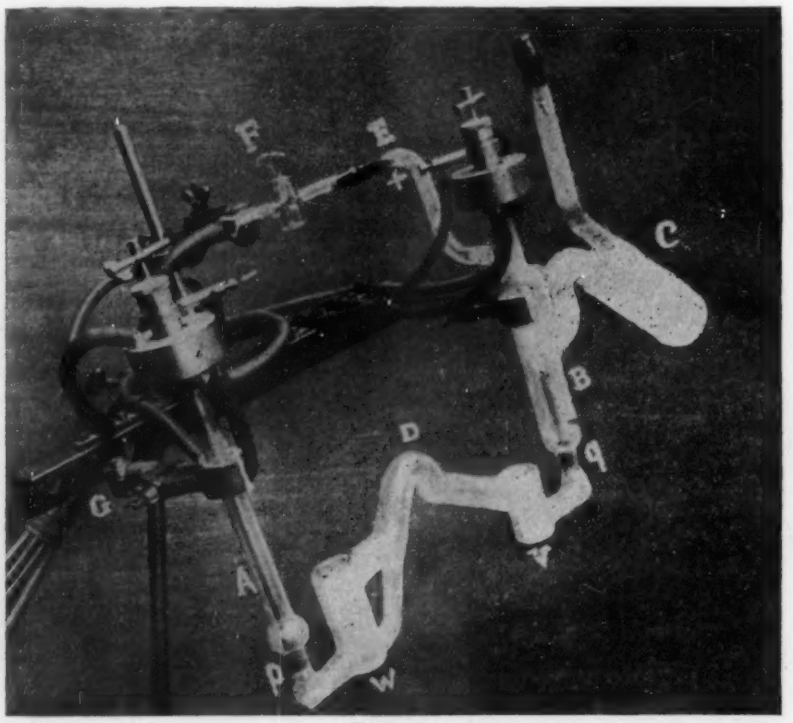


FIGURE 3

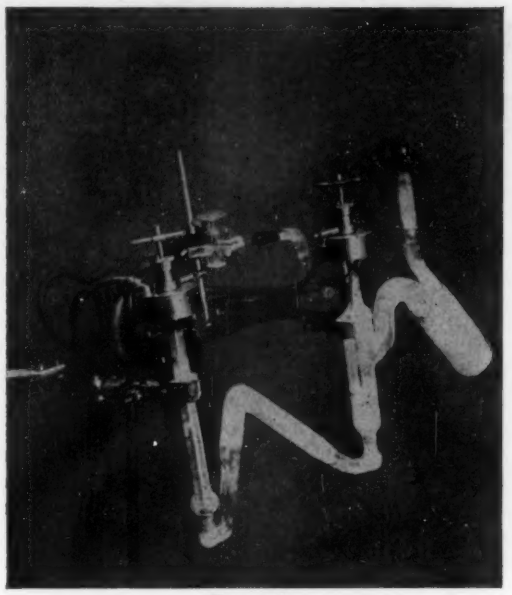


FIGURE 4

lamp closely resembling Jaenicke's lamp. A photograph of our lamp is given in Figure 3. The two legs, A and B, are bent upwards and the lower ends of the steel electrodes are provided with pieces of carbon, ground to a tight joint into the legs, so that they can serve for cocks just as in the lamp of Jaenicke. The tube of the lamp having an inner diameter of eighteen millimeters (about ¾ of an inch) contains two double-walled coolers W and V, similar to those used by Jaenicke. There is, however, some difference. Our lamp contains, of course, the storage vessel C, and as we intend to work at different pressures the electrodes had to be connected with the legs of the lamp in a completely airtight manner, and yet it had to be possible to turn the graphite plugs up and down to serve as a cock. This problem was solved completely without the use of mercury. Without entering into details, we will only say here that this lamp was burning with an arc length of 12 centimeters (about 5 inches) at 40 volts and ± 30 amperes.

As the voltage was increased only slightly in comparison with the result obtained with our first lamp, another lamp was constructed in which an arc of sixteen centimeters (about 6 inches) length could be produced. The quartz coolers U and V were removed and the lamp shown in Figure 4 was built.

This lamp gave better results, the voltage could be increased to 50 volts but, of course, as we were not yet satisfied, we tried another lamp of larger dimensions. So we constructed the lamp shown in Figure 5.

This lamp is mounted on a stand provided with a wide copper tube with a series of gas burners to keep the lead in the lamp in a molten condition. Further, it is provided with two other copper tubes, connected with a conduit pipe of the compressed air supply, to cool those parts of the lamp which are heated too highly by the electric arc.

This lamp satisfied us best; working not in a vacuum, but increasing the pressure by pure nitrogen, the voltage could be increased to ± 120 volts, while the length of the electric arc was 15 centimeters (about 6 inches) and the strength of the current ± 15 amperes. The only way to reach higher voltages is by increasing the pressure and this lamp lent itself excellently to that purpose.

The next illustration, Figure 6, shows this lamp heated by the burners; Professor Smits is on the right and Dr. Karssen on the left.

In Figure 7, finally, the lamp is shown burning.

We will not omit here to thank the members of the Technical Staff, J. Ch. Pater and J. Gunter for the great accuracy with which they have constructed the metallic and glass parts of the different lead lamps.

[EDITOR'S NOTE.] Following Professor Miethe's announcement, a little more than a year ago, that he had successfully transmuted mercury into gold, at least three other scientists have been at work on similar experiments. One is Professor Nagaoka of the Institute of Physical and Chemical Research, Tokyo, Japan, who claims in a detailed letter to *Nature* (London, issue of July 18) that he has been successful. Another test is now being completed by Prof. H. H. Sheldon, physicist, of New York University, expressly for the Scientific American, as was announced in our December, 1924, issue and partly described in our issue of last March. The third transmutation experiment is being made by two Dutch scientists of the University of Amsterdam, who have furnished the Scientific American with the article on these pages.

"Just what is it that all these scientists want to accomplish? How could one element be changed into another? Are they trying to find an easy way to get rich?" Frequently we are asked just such questions. The answer is, it is not gold, as such—not gold as wealth—that they want, but a *transmutation*. Thus *any* other element would do as well. Why is it, then, that they chose to try for gold? The answer sends us to the periodic table of atomic weights which is to be found in our textbooks of chemistry. Here the elements are arranged in order of their atomic weights. Thus, for example, the atomic weight of lead is 207.2; that of mercury is 200.6; that of gold is 197.2. Now a difference, it is believed, between all the respective elements lies in the number and arrangement of the outside or valence electrons, and the numbers expressing atomic weights are believed to correspond in a definite manner to the numbers of these valence electrons.

Logically, at least, if we can find a way to knock electrons out of the atoms we should thereby effect a transmutation. If we choose to begin with mercury—an especially convenient element—we should expect to get gold; likewise, if we began with lead we should expect to get mercury, for mercury's atomic weight is less than that of gold.

The two Dutch scientists whose preliminary work is described here by themselves are trying to transmute the lead atom into another element. Although they have not yet completed their experiments, their work alone in perfecting the ingenious apparatus illustrated on these pages is in itself a remarkable triumph of invention.

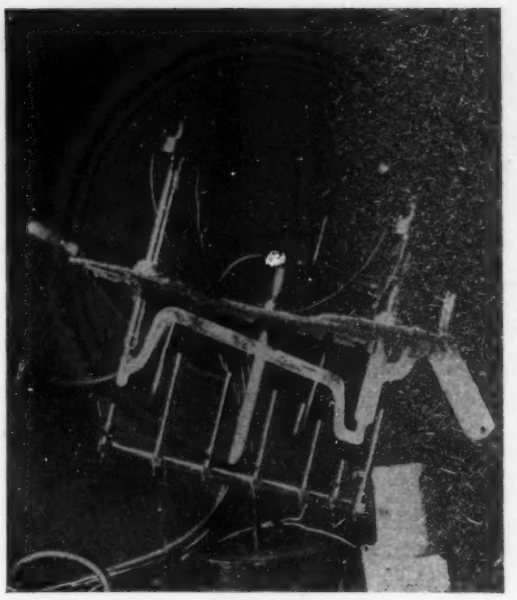


FIGURE 5

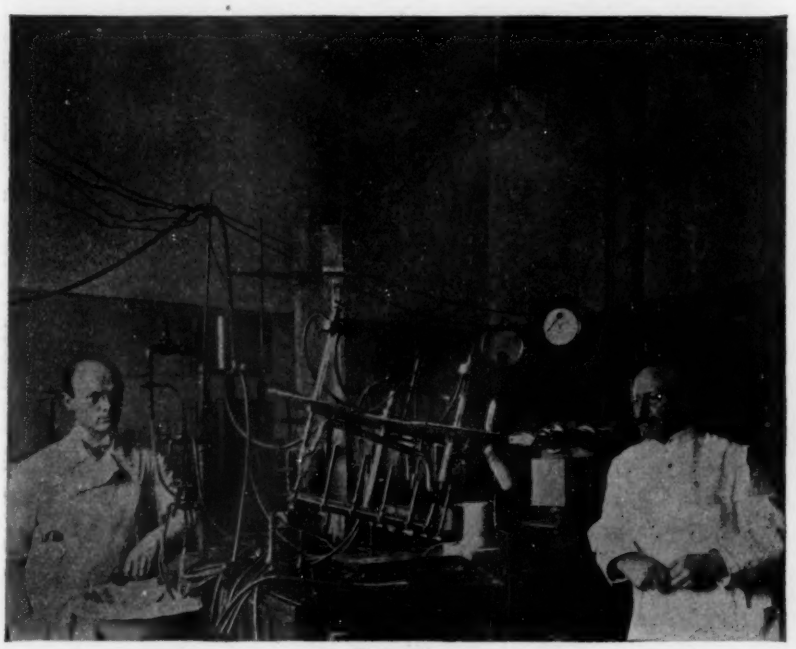


FIGURE 6

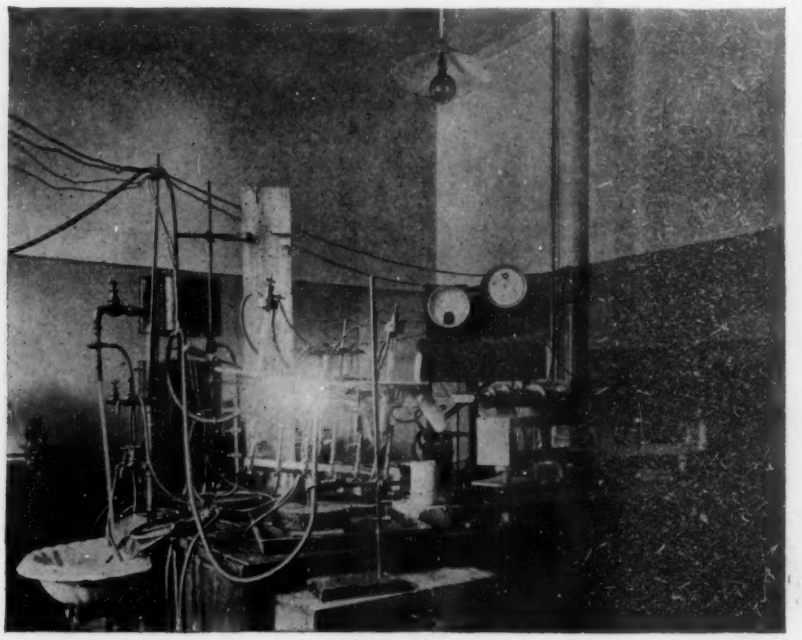


FIGURE 7

Making the Movie Film Give the Music Cues

With This Invention the Orchestra Leader Need Never Look at the Screen

SUPPOSE the gifted Hungarian director is swinging the orchestra through the lively strains of a mazurka as the motion picture screen shows the dancing scene in a Gypsy camp. The dancers part to make way for the wedding scene. Mendelsohn's wedding march is in order.

But, leaning on the arm of the Hollywood bridegroom is the very girl who promised to wait in Budapest for the orchestra leader.

What happens to the music?

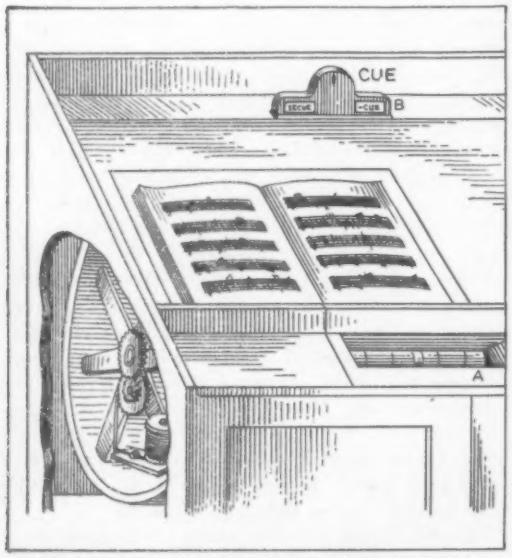
Better music in motion picture theatres can be attained if the orchestra leader is not obliged to keep looking up at the screen. With the need for keeping an eye constantly on the players to the right and left of him as well as on the score before him and with ears open for every note played, he is busy enough as it is.

In order that he may concentrate on the job of producing good music, Mr. S. W. Lawton, general musical director of the Keith-Albee and B. F. Moss theatres, has invented a musical guide for him. An electric connection between the music stand and a mechanism attached to motion picture machines gives directions on a paper cylinder which turns in front of the conductor just below his music.

When the preliminary run of the picture is made the orchestra leader writes on the paper record the music that is to be played for each scene, the time and all the other necessary notations. Each "cue" is announced by an electric warning signal. This is at the back and is shown at "B" in the lower right-hand illustration.

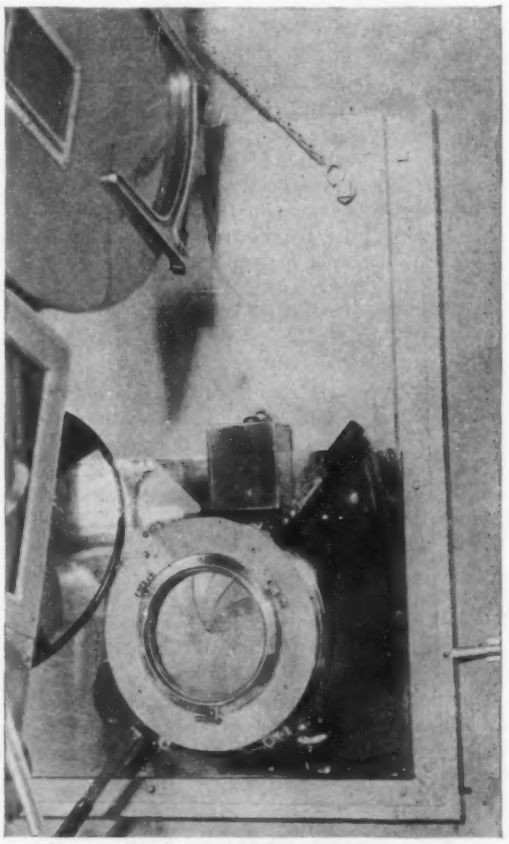
The illustrations show parts of the apparatus in the projecting room and in the orchestra pit. In the lower left-hand picture we see the transmitting device connected with the projecting machine. It is actuated by the film and, by contact with an electromagnet in the orchestra conductor's stand, causes the cylinder to make a slight turn and display the musical directions necessary at that particular moment. An electrically lighted magnifying glass allows the leader to see the directions in the dark.

These pictures were made in the B. F. Moss Colony Theatre, 53d Street and Broadway, New York City.



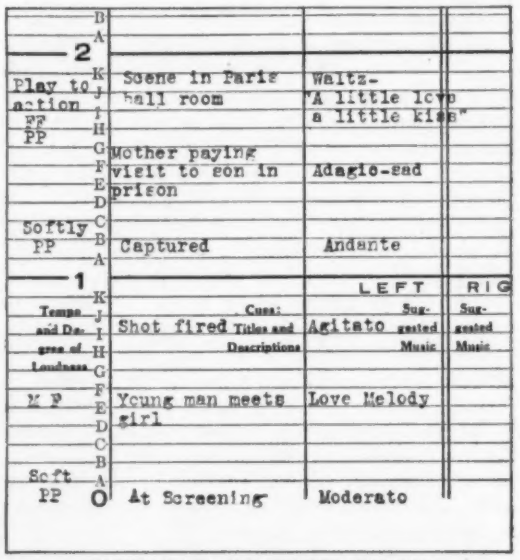
THE MUSIC STAND, SHOWING MECHANISM

The cylinder which carries the sheet containing instructions is shown below the top. Cues are visible at "A" through a magnifying glass and signals at "B" call attention to cues and give notice to turn the page



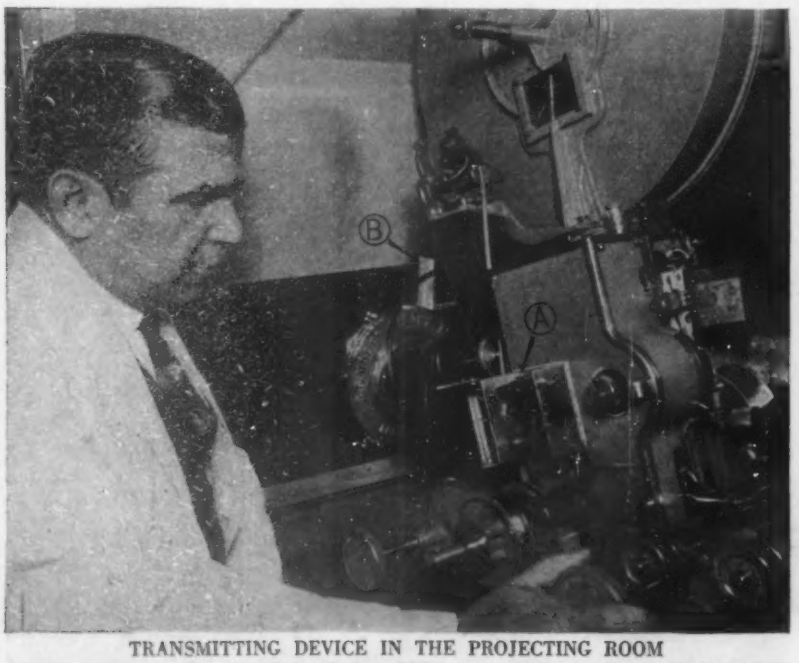
THE AUTOMATIC SWITCH

The automatic switch is located on the iris diaphragm and when the projectors are changed connection is made automatically with the director's music stand



SAMPLE OF THE PAPER RECORD

This is a small part of the record encircling the cylinder, prepared at rehearsal. It is rendered visible at "A" below, where it is revealed through a magnifying glass, thus obviating looking at the screen



TRANSMITTING DEVICE IN THE PROJECTING ROOM

At "A" will be seen the transmitting device which is operated by the film itself and at "B" is shown the automatic switch which transfers the signals from one projecting machine to another when machines are changed to allow replacement of films

DR. EDWARD KILENYI CONDUCTING HIS ORCHESTRA

He does not have to look at the screen for music cues; he gets them from the illuminated record prepared at rehearsal. At "B" is the signal telling him to look for cues or turn a page. At "C" is the lamp which shows whether everything is in working order

Checking the Magnetic Permeability of Iron

A New Method for the Quick Testing of Cores and Wire for Radio and Other Apparatus

By Paul B. Findley
Bell Telephone Laboratories, Inc.

ELECTRICAL transformers and many other coils used in power and telephone work and in radio have iron cores to increase the magnetic lines of force due to the currents flowing in them. To design these properly requires an accurate knowledge of the magnetic properties of the various kinds of iron used, especially of their "permeability," which means the ratio of the magnetic flux density produced to the magnetizing force. Roughly, this means the ease with which that kind of iron accepts magnetization.

To transmit the extremely small amounts of power that pass through a radio transformer or over a telephone line, at frequencies ranging from 100 cycles per second up into the thousands, and to obtain good quality of transmission, it is necessary that the iron cores used, for example the cores of the loading coils inserted at intervals in the telephone line, should be of a uniformly high grade. Every batch of raw iron alloy must be tested to assure uniformity in magnetic properties. To avoid the necessity of winding a special coil on each such sample, Mr. G. A. Kelsall of the Bell Telephone Laboratories has developed an ingenious way to avoid any such wire winding at all. Where it would take nearly a day to make this magnetic test on one sample by the old methods, Mr. Kelsall's device enables one operator to put several hundred samples a day through their paces.

The new apparatus is called a permeameter. The necessity for winding a large number of turns of wire on each sample is eliminated by using a special form of transformer. The primary of this transformer is wound on a laminated core of permalloy, the new nickel-iron alloy of high magnetic permeability. The secondary of the transformers consists of one turn, which is not a wire at all but, a copper shell, surrounding the primary and with additional space provided for the sample to be tested.

In the bottom of this copper shell lies the transformer core with the 700-turn primary coil wound

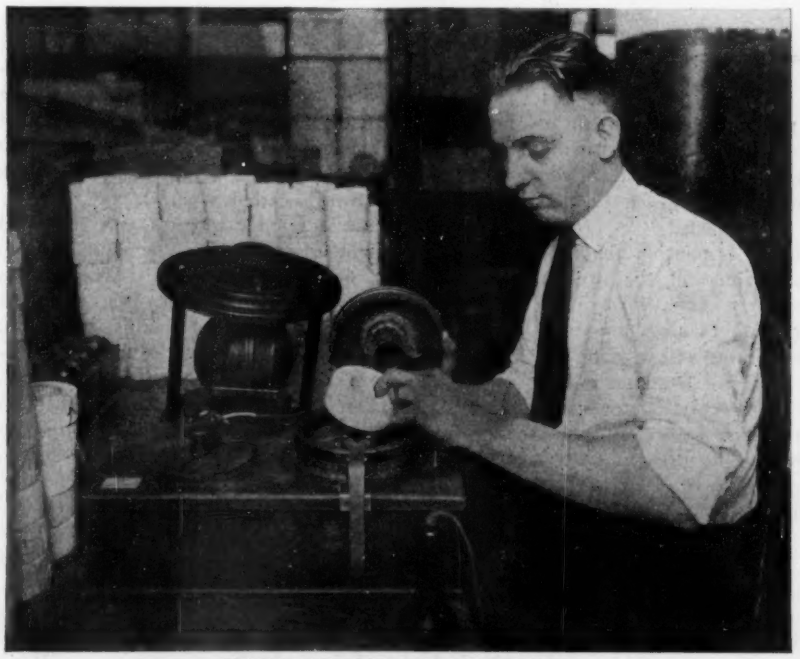
INSIDE THE PERMEAMETER
The small ring of iron lying on top of the horizontal partition is a sample for test

on it. The copper shell is divided into two compartments by a horizontal partition, on which the sample to be tested may be placed. The secondary is closed by means of a copper cover, the center tube of which makes contact with the center tube of the container. The outside edge of the cover also makes contact with the outside edge of the container.

When the secondary is closed without any test sample in place, the inductance, as measured from the primary terminals, is extremely low. We then have, in effect, a short-circuited transformer. But when an iron sample for test is inserted and the cover again put in place, the test sample is interlinked magnetically with the secondary. This increases the inductance of the permeameter as measured from the primary terminals. The amount of increase in inductance depends on the magnetic permeability of the sample and its dimensions. Knowing the dimensions of the sample, it is possible to calculate its permeability. Where all the samples have the same dimensions as, for example, when one is testing cores for radio transformers or loading-coils for a telephone line, the calculations are made once for all. A single reading of the instrument gives the permeability.

For the inspection of the iron wire used in making loading-coils, a special type of permeameter is used. This fits the brass spools on which the wire is supplied by the manufacturer. It has been found that since two of the dimensions of each spool of wire are fixed by the brass spool, namely, the inside diameter of the coil and its axial height, the third dimension, that is, the radial thickness, is found with sufficient accuracy from the weight of the wire. Thus, routine acceptance tests for this wire are made by weighing the spools and by measuring the inductance of the permeameter with the spool of wire inserted. This procedure has been simplified still further by making up a special slide rule on which the factors for the necessary calculations are laid out logarithmically. Knowing the inductance reading of the permeameter and the weight of wire, one setting of this slide rule gives the permeability of the iron wire under test.

This permeameter determines the permeability as accurately as by the old method and has greatly facilitated research work on magnetic substances, as well as the routine inspection work. For measurements at high temperatures, Mr. Kelsall has developed a form of the instrument in which the sample to be tested is enclosed by an electric heater with an insulating jacket and ventilating system, the whole being then enclosed in the copper shell of the permeameter. By this method, the electrical circuits can be kept at or near room temperature, while the sample itself is carried over a range of temperature from that of liquid air to as high as one thousand degrees, Centigrade.



INSERTING ANOTHER TEST PIECE
The cover of the permeameter is about to be put in place

HOW THE TEST IS MADE
As the variometer is altered, the sound in the telephone changes

Evolution, from the Nebula to 1925

The Story Outlined by the Chart on the Opposite Page

By Albert G. Ingalls

THE principal feature of the geologic chart shown on the page opposite is its unique method of indicating the vast lapse of time since the formation of the earth.

If you will look at the extreme left-hand column of this chart—the column captioned "Years Ago"—you will note that it is divided into nine equal spaces, one above the other. These equal spaces represent *unequal* intervals of time. Each space represents *ten times* as long a duration as the space next below it.

By means of this logarithmic scale we can represent the later periods of geology and evolution—which are perhaps the most interesting and significant ones—on a scale sufficiently large to display them suitably, at the same time representing the older periods in a definite, mathematical relation to them, without exceeding the length of one page. If we should attempt to represent the entire chart on the same scale as the lowest space, it would be more than 300 miles long!

This method was submitted on the accompanying chart in partly completed form, by Mr. John B. Sparks, who also employs the curves shown in the central column of the chart to indicate the dominance of various types of life and the differentiation of the racial stocks of man. For the upper part of the chart, however, the writer is responsible.

It will be noted that the curves representing the various organisms are brought together at the bottom, indicating that man is dominant over the other animals. This was done thus only because the chart had to be accommodated to the size of the page. Man is dominant today only in one sense. In another sense he is not. There are as many fishes, for example, in the world today as there were in the Age of Fishes when fish first became numerous. Likewise the reptiles are still important.

Dinosaurs Became Extinct

We begin our account with an immense, hot nebula of gas in slow rotation. As this nebula cooled it contracted, and as it contracted it rotated faster. This made the nebula bulge more or more at the sides until finally after it had flattened down like a round lens some of its matter was thrown off, not in rings, but in two oppositely directed streams, which condensed into very many millions of stars, one of which is the Sun.

Thus far, our story explains the creation of our galaxy. We must now account for the creation of the planets. For an inconceivably long space of time the Sun existed in space unaccompanied by any planets. Finally a star passed by accident quite close to the Sun—without actually colliding—and by its gravitational attraction it drew away from the Sun's face about one-tenth of one percent of its whole substance. As it passed on by the Sun, it imparted to these separated particles a sidewise motion, setting them in revolution around the Sun. Subsequently the larger of them, acting as nuclei, swept up the rest, thus forming the planets. This is the Planetesimal Hypothesis, and it is now the most plausible theory in the field; while the Nebular Hypothesis (rings thrown from a revolving solar nebula) has been proved impossible and science has accepted its demise.

Some time after the surface of the earth had cooled enough to solidify, life commenced. From primitive, one-celled types of life, every living thing on earth today is believed to have evolved. We have no space to tarry over the early geologic periods. We are chiefly interested in this brief account in putting our finger on some of the times when new and more significant types came into being.

The Permian Period is therefore full of significance, for in it the first of the warm-blooded, mammalian development may be traced. At this time the reptiles themselves had not long since evolved from some earlier form. Thus, early in the course of evolution of the reptiles *one kind* of reptile began to differentiate in a peculiar and interesting manner, and a few million years later it had developed warm blood from cold blood. It had also acquired specialized teeth of the mammalian type, that is, teeth corresponding to molars, canines and incisors. These so-called "cynodont" or dog-toothed reptiles are extremely significant to us because they are the distant ancestors of all the mammals, including man. Let us regard them as progressive reptiles.

Noted Books on Evolution

For further reading on cosmic and organic evolution we recommend the following books, chosen for their basic nature: For the time of the parent, spiral nebula, Prof. J. H. Jeans' "Problems of Cosmogony and Stellar Dynamics." For the formation of the planets, Prof. T. C. Chamberlin's "The Origin of the Earth;" Harold Jeffrey's "The Earth;" Jeans', as above. For cosmic and geologic time, Pirsson and Schuchert's "Text-book of Geology," Part II only—"Historical Geology." For the evolution of reptiles, mammals, and so on, R. S. Lull's "Organic Evolution;" Prof. Henry Fairfield Osborn's "Origin and Evolution of Life." For evolving man, Prof. George Grant MacCurdy's "Human Origins." For the races of man, A. H. Keane's "Man, Past and Present."

These cynodonts were plain, unspecialized, and lizard-like and we must not think, when we hear that the mammals evolved from the reptiles, that the great dinosaurian reptiles are meant. Instead, the dinosaurs were a later side branch which became utterly extinct, leaving no descendents.

Here let us stop to answer a question that has bothered many, particularly some of the present anti-evolutionists: "If these early animal forms long ago evolved into *other* forms," they ask, "how is it that we still have the earlier forms with us today?" What happened is this: at any given stage of evolution a *part*, only, of these types evolved into higher forms, because only a part were thrown into such environments that they received an urge to evolve. Many of the others have come down to our time as "living fossils," comparatively—though not entirely—unchanged.

At the close of the Age of Reptiles, the dinosaurs rapidly became extinct. They did not dwindle through long epochs, but some comparatively *rapid* event ended them—possibly within a few generations. Here the temptation to assign a sudden cataclysm is strong to those who have not examined the evidence of the rocks. Those who have examined the evidence see stratum on stratum, each containing many dinosaur fossils. Then with the next stratum these fossils are gone—absolutely gone. Had there been some cataclysm, however, would the strata lie so evenly bedded, just like the rest? It is a great enigma.

Although the dinosaurs were reptiles, there were, of course, other reptiles that were not dinosaurs. One kind, which early differentiated from the evolving dinosaur stem, has sent its descendents down to our time, as birds. In addition, we still have the lizards, snakes, turtles and crocodiles, reptiles whose ancestors survived the dinosaurian extinction.

With the dinosaurs extinct we come once more to one of these interesting times when evolution was speeded up—for evolution is not a uniformly rapid process; its speed depends very decidedly upon environmental conditions. Sometimes it stagnates—then it leaps. The little mammals that had thus been evolving very slowly while the dinosaurs had thundered above them now found themselves unexpectedly in possession of a world, and they proceeded to make the best of it by increasing in bulk and by differentiating into several orders. These orders, different as the animals involved superficially seem, are all closely related.

Man came very recently, in a comparative sense, though in an absolute sense he is very ancient—doubtless more than a million years old. He differs from the remainder of the order of primates chiefly in the possession of a far superior brain.

Early man lived on for thousands of generations in very much the same level of culture. His advances were painfully slow.

What of Man's Future?

Man's modern scientific and mechanical culture is only an infant—only a few hundred years old. His mind has been unchained from blind control by custom for only a century or two. Before that, his acts were controlled largely by superstition. Superstition is simply the *in*-comprehension of how our world actually works.

At last we have come to see that the whole universe works on a *regular plan*, not in an accidental fashion. This realization has given man more control of his environment in five generations than his human forebears, with their ignorance of the world in which they lived, were able to gain in 20,000 previous generations. This comprehension of the world's true nature is called Science.

There are two ways by which man's new and invaluable insight into nature may be injured. One is through wars between man and man. The other is more dangerous. Organized superstition opposes science and would destroy it by law if it could. This would cut off from our descendents the precious stream of exact knowledge already gained by man after great labor and under the fire of constant opposition. If, on the contrary, ignorant estopping hands can be kept from science for a few more years, there is reason to think that man will learn the true meaning of the world he lives in and how to control his destiny himself, instead of allowing outside events to control it. Human life will then be more happy, more worthy, and vastly more significant.

That is why we have added to our chart in the lower right-hand corner, where the future is indicated, the hopeful words, "Science Reshaping Man's Environment."

EVOLUTION, FROM THE NEBULA TO 1925.

YEARS AGO (LOGARITHMIC SCALE)	GEOLOGIC ERAS — PERIODS, EPOCHS, ETC.	RELATIVE DOMINANCE OF ORGANISMS	COMPARATIVE DATA
	TIME OF SPIRAL NEBULA	A ROTATING MASS OF GAS THREW OFF DETACHED MASSES. THESE FORMED MILLIONS OF STARS,—OUR GALAXY.	THE SPIRAL NEBULAE, OR GALAXIES, ARE PROBABLY ISLAND UNIVERSES.
	TIME OF SOLAR NEBULA	ONE OF THESE STARS PASSED NEAR THE SUN AND DREW AWAY A MASS OF IT, SETTING IT IN REVOLUTION.	THIS COULD NOT HAVE HAPPENED MORE THAN 14,000,000,000 YEARS AGO—JEFFREYS
10,000,000,000 years 10^{10}	TIME OF PLANETARY AND LUNAR GROWTH	CONDENSATION OF NUCLEI (PLANETS) IN THIS REVOLVING MASS OF MATTER, AND THEIR GROWTH, DUE TO THE INFALL OF SMALLER MASSES.	THESE SMALLER MASSES ARE CALLED PLANETESIMALS, AND CONTINUED TO FALL DURING MILLIONS OF YEARS.
	AZOIC TIME (LIFELESS)	THE EARTH'S MOLTEN EXTERIOR SOLIDIFYING. AN ATMOSPHERE RICH IN CARBONIC ACID FORMING. PERPETUAL RAIN COOLING THE EARTH. THE OCEANS FORMING.	THE OCEAN BEDS SUNK. THE HEAVY ATMOSPHERE FINALLY PURIFIED.
	EOZOIC TIME	DAWN OF LIFE — Single cell organisms	LAND AND OCEANS COOLING DOWN.
1,000,000,000 years 10^{9}	ARCHAEOZOIC ERA	AGE OF LARVAL LIFE — Abundance of microscopic algae.	VAST UPWELLINGS OF MOLTEN ROCKS. PROFOUND CRUSTAL EROSION.
	PROTEROZOIC ERA	AGE OF PRIMITIVE INVERTEBRATES	PRIMITIVE INVERTEBRATES, e.g., worms.
	CAMBRIAN PERIOD	AGE OF INVERTEBRATES — Trilobites, Molluscs, Etc.	RISE OF LAND PLANTS AND CORALS.
	ORDOVICIAN PERIOD		
	SILURIAN PERIOD	AGE OF FISHES	FIRST LUNG-BREATHERS.
	DEVONIAN PERIOD		
	CARBONIFEROUS PD.	AGE OF AMPHIBIANS	PRIMITIVE REPTILES EVOLVING.
	PERMIAN PERIOD		MAMMAL-LIKE REPTILES EVOLVING.
	TRIASSIC PERIOD	AGE OF REPTILES — Great dinosaurs — Extinction of dinosaurs	FOSSILS OF CYNODONT REPTILES
100,000,000 years 10^{8}	JURIASSIC PERIOD		RISE OF TOOTHED BIRDS. SIERRA NEVADA'S THROWN UP.
	CRETACEOUS PERIOD	BIRDS	RISE OF FLOWERING PLANTS. — ROCKY MOUNTAINS THROWN UP. —
	EOCENE EPOCH	AGE OF MAMMALS — Egg-Laying Mammals; Pouched Mammals; Armadillos, Sloths; Rodents; Carnivores; Hoofed Mammals; Sea-Cows; Whales; Seals; Shrews, Moles; Bats; Lemurs; Monkeys-tailed; Apes-tailless; Primates	ARCHAIC OR CRUDE MAMMALS DIE OUT.
	OLIGOCENE EPOCH		RISE OF HIGHER MAMMALS AND PRIMATES.
10,000,000 years 10^{7}	MIOCENE EPOCH		LARGE ANTHROPOID APES. CULMINATION OF AGE OF MAMMALS
	PLIOCENE EPOCH	Java man; Neanderthal man; Broad-headed man; Rhodesian man; Africian negroids; Mongol; Alpine; Proto-nordics; Mediterraneans; Negroes; Arabs; Proto-Egyptians; Indo-Afghans; Mediterraneans; Nordic + Mediterraneans; Nordic; Nordic + Alpine; Alpine + Mediterreans; Alpine + Proto-Nordic; Minoans; Romans; Teutons; Scandanavians; Turks; Huns; Slavs invade Europe; American Indians	MAN'S BRAIN APPROACHING HUMAN STANDARD, (KEITH).
1,000,000 years 10^{6}	Foxhallian Culture, (Stone).		CRUDE FLINT IMPLEMENTS IN ENGLAND, THE MOST ANCIENT AUTHENTICATED EVIDENCE OF MAN.
6,000,000			
5,000,000			PITHECANTHROPUS, JAVA APE-MAN.
4,000,000	FIRST GLACIATION — Cromerian Culture (Stone)		? EOANTHROPUS, OR PILTDOWN MAN
3,000,000	SECOND GLACIATION — Chellean Culture (Stone)		HEIDELBERG MAN
2,000,000			RHODESIAN SKULL
100,000 years 10^{5}	THIRD GLACIATION — Acheulian Culture (Stone)		TALGAI SKULL.
			WADJAK MAN
	Mousterian Culture (Stone)		NEANDERTHAL MAN
48,000 B.C.	FOURTH GLACIATION		BOSKOP SKULL.
38,000 B.C.			
28,000 B.C.	Aurignacian Culture (Stone)		AGRICULTURE CERTAIN IN EGYPT
18,000 B.C.	Solutrean Culture (Stone)		
	Magdalenian Culture (Bone)		CAVE-ART IN WESTERN EUROPE
10,000 years 10^{4}	Azilian-Tard. Culture		SUMERIAN CIVILIZATION DAWNS
9,000	Neolithic Culture (Stone)		EGYPTIAN CIVILIZATION DAWNS
8,000			NIPPUR AND ERIDU FLOURISH
7,000	Copper Age		
6,000	Bronze Age		HAMMURABI
5,000			
4,000			CONFUCIUS
3,000			BUDDHA
2,000	Iron Age		JESUS
1,000			MAHOMET — Arabian Civilization
	Christian Era Begins		
1,000 years 10^{3}			MAGNA CHARTA
1100			RENAISSANCE
1200			
1300			
1400			ENGLISH REVOLUTION
1500			AMERICAN AND FRENCH REVOLUTIONS
1600			
1700			
1800	INDUSTRIAL AGE BEGINS — Railways — Invention		DARWIN — Origin of Species, 1859.
	Social Reform		
1900			WORLD WAR
1925		Greeks, Italians, French, Germans, British, Hindoos → Americans	SCIENCE RESHAPING MAN'S ENVIRONMENT

Growth of the British Dominions

Astronomic — Geologic Time — Historic Time

Archaeozoic Era — Proterozoic Era — Paleozoic Era — Mesozoic Era — Cenozoic Era

Pre-Cambrian Period — Tertiary Period — Pleistocene Epoch

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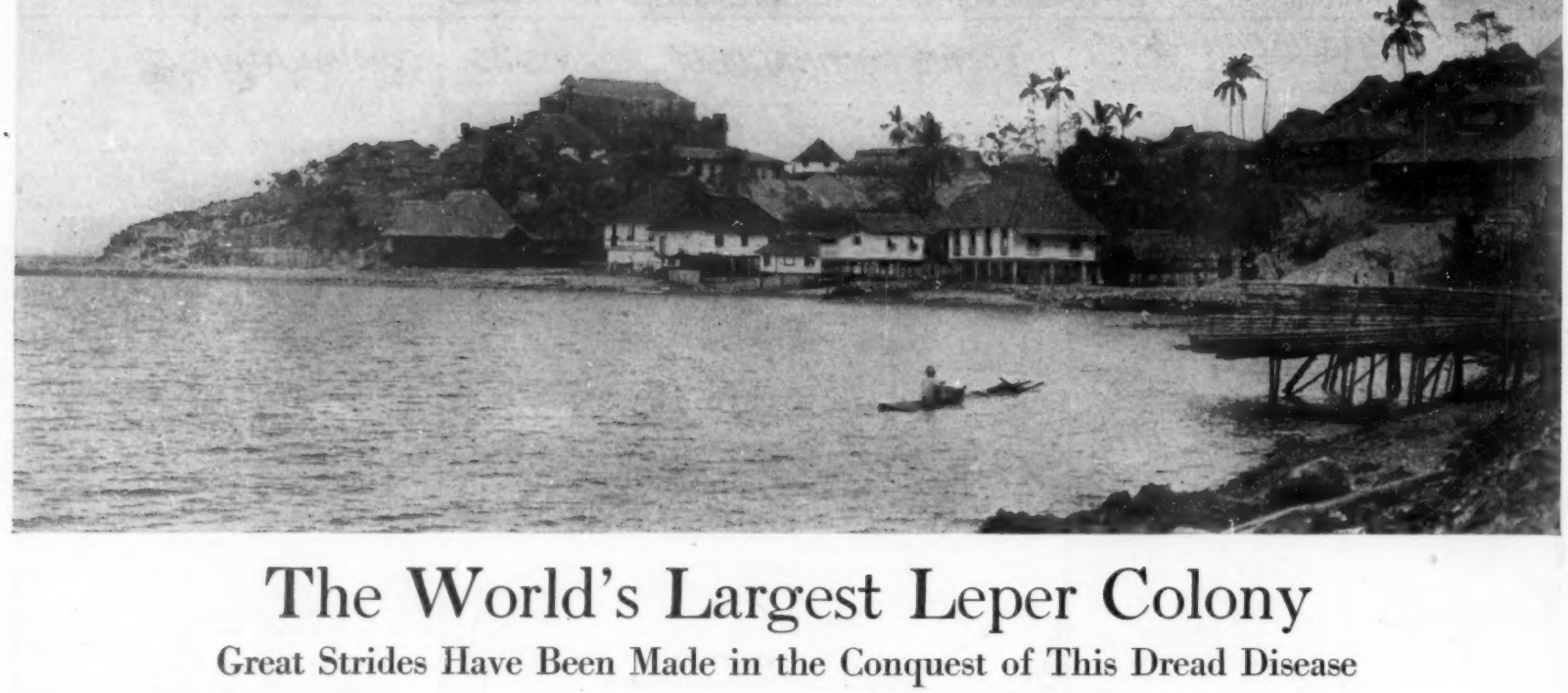


The World's Largest Leper Colony

Great Strides Have Been Made in the Conquest of This Dread Disease

(CONDENSED ARTICLE)

By Victor G. Heiser, M.D.
Director for the East, The Rockefeller Foundation

SCARCELY had the United States Army landed in the Philippines before its medical officers learned of the huge leprosy problem. The unfortunate victims of this dread disease were to be found on almost every island of the many hundreds that make up the inhabited Philippine Archipelago, some eking out miserable existences on isolated sandspits, others begging in the market place, and still others trying to earn a pitiful living by making cheese and engaging in other industries. All were more or less abandoned except the few ministered to by the faithful priests and sisters of the Catholic Church. During the period of army occupation measures were put in force to alleviate the miseries of these sufferers and to prevent the spread of the disease. Then as the Army gradually withdrew the civil authorities assumed responsibility for the continuance of this work.

Hope Lies in Segregation

The hope of control lay in segregating all the lepers in a colony. The number to be cared for was unknown. Estimates varied from 2,000 to 10,000, which made it extremely difficult to judge the extent of the accommodations to be provided and the area required for the new colony. Many questions had to be met: If agriculture was to contribute toward the support of the colony, what amount of land would be ultimately necessary? If industrial occupations were to be relied upon, what form should they take? Could the colony be made self-supporting through fishing or cattle raising?

Careful search was made for a site for a leper colony. The island of Culion seemed to combine the most advantages and was made ready for the reception of lepers in 1906. Culion is one of the beautiful islands of the Philippine Archipelago. It extends twelve miles in a northerly and southerly direction and measures some twenty miles at its widest part. Those connected with the early construction days believed that the area in the vicinity of the houses should be bare of trees and vegetation to reduce the danger of infection. This brought much criticism in later years and, as there was every reason to believe that the danger of transmission is not increased through vegetation, for the past twenty years continuous effort has been made to restore and beautify the denuded area.

As thousands of lepers had to be provided for, a complete self-constituted community was necessary. A whole town had to be constructed. What this meant on an island several hundred miles away from Manila and an ocean away from markets that could supply the necessary building materials may well be imagined. There were heartbreaking delays.

Brown Brothers

GOVERNOR-GENERAL LEONARD WOOD

His aim is to give all lepers an opportunity to avail themselves of treatment

Civic problems had to be met. Obviously, for a town of several thousand persons local self-government was desirable. To avoid institutionalism suffrage was introduced, and to Culion belongs the distinction of being one of the first places under the American flag to give the ballot to women. A mayor and councilman were elected, and they in turn appointed a police force of lepers who were charged with the responsibility of maintaining public order in the leper community. One of the problems of leper colonies is to prevent escapes. At Culion the leper police performed this duty so well that it was unnecessary to have outside guards. At times homesickness became so acute and desire to visit their native places so strong that a few patients with crude bamboo rafts and sails of matting risked the perilous China Sea to reach their homes. But the interesting fact was that after these cravings had been satisfied they often voluntarily asked to be returned to Culion.

Large Percentage of Cures

The lepers of the Philippines were scattered among hundreds of islands in thousands of remote spots. As Filipinos have strong attachment for their homes, the idea of leaving familiar surroundings and taking up residence in Culion was naturally abhorrent to them. The question, then, was how to induce them to go. As the leper is in no sense a criminal, police methods were not indicated and the policy of education and persuasion was inaugurated. The aid of the provincial governors was enlisted, and they in turn instructed subordinate officials to explain the advantages of segregation—an assured decent living, and the hope that treatment would afford relief. The simple facts dealing with leprosy control were explained in the schools. After the Filipino people once understood that the ultimate eradication of leprosy was the goal of segregation and that in the meantime segregation meant far better care for the lepers themselves than they could possibly have in their home surroundings, they acquiesced in the measures.

In the early days the collection of lepers was greatly aided by the cures that were made of hundreds of persons who had been branded as lepers, but who in reality were afflicted with other diseases. Segregation was further aided by the discovery of a treatment which resulted in the cure of some lepers, thus further demonstrating the Government's concern for the welfare of these unfortunates.

After the first few hundred lepers had arrived at the Colony they began writing their friends of the delightful surroundings and benefits. Moving pic-

PROBABLY A CURABLE CASE

Photograph of one of the lepers at Culion showing the ravages of the disease

ture films showing life at Culion were exhibited throughout the Philippines. Through the success of the measures employed, in a comparatively few years the great majority of lepers were transferred to Culion. However, there still remained a small number whose opposition could not be overcome except by resorting to legal compulsion.

When the time came for the first leper ship to make its maiden trip the real fear that exists in the human heart asserted itself, and scarcely an hour before the time set for departure the crew deserted except for the Yankee Skipper, Hilgrove, and the Chief Engineer, Sawyer. Then began the arduous task of assembling a new crew. But after this initial difficulty no serious trouble was experienced in that respect. As the leper plans became better understood, more and more popular support was given. When it is recalled that this often meant the separation of husbands and wives, brothers and sisters, parents and children, and the parting from dear friends, it is much to the credit of the Filipino people that they readily acquiesced in the measures.

In the early years of segregation the prospects of successful treatment were discouraging. In the centuries of man's efforts to control leprosy almost all the remedies in the pharmacopoeia were tried. Even the ever-present medical quack held out no hope of cure. Of all the remedies tried, chaulmoogra oil alone infused real hope. For many years reports from India indicated that the use of chaulmoogra oil was followed by beneficial results. Unfortunately, the nauseating properties of this drug were so great that its general use was impracticable. It was in the Philippines that a method for administering the oil by hypodermic injection was first successfully employed. The result was achieved through adding camphor and resorcin to the oil thus causing its absorption, which does not occur when the oil alone is injected.

The news of the successful use of chaulmoogra oil in the Philippines spread rapidly, and soon afterwards encouraging reports were received from many other countries. The effect on sufferers from leprosy exceeded all expectations. Afflicted persons in the early stages of the disease came forward and sought treatment. Thus were eliminated many centers of infection that had remained under former plans of dealing with the disease.

The success in the Philippines had the effect of creating a world-wide interest in leprosy, and soon modern research laboratories in many countries were contributing improvements in the original treatment of this disease which had hitherto received but comparatively little attention.

Enough experience with treatment has been had to enable the Governor-General of the Philippines to say that 449 lepers have become negative to the most delicate tests for the disease, and that several hundred are expected to be "negative," that 75 percent of the cases under treatment are improved, and that 196 have returned to their homes as cured.

There are now some 6,000 lepers in segregation in the Philippines. This involves enormous administrative problems and costs. Since General Wood assumed office it has been his aim to give all the lepers an opportunity to avail themselves of treatment. The organization of that service has been a stupendous task, and nowhere has medical treatment on so large a scale ever been attempted.

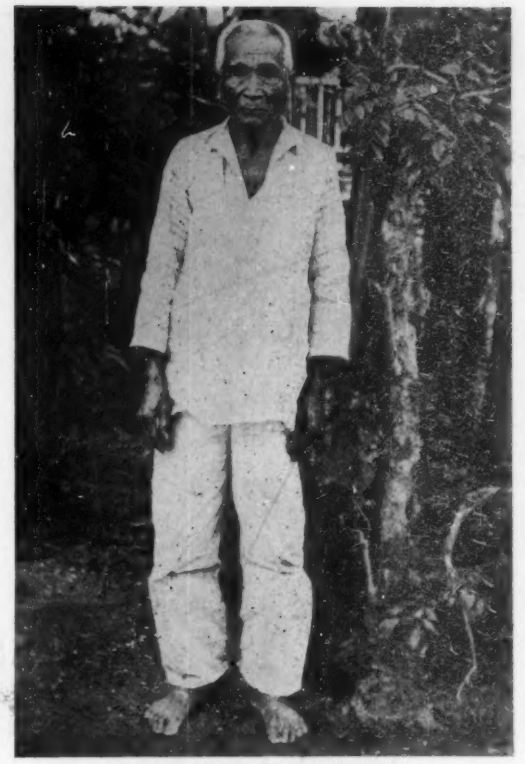
The huge number of lepers in the world's largest leper colony affords extraordinary opportunities for further research and study of the disease. The Philippine Government has done much, but its resources are limited and additional aid is needed.

Leprosy

For centuries leprosy has struck terror into the heart of man. There is no affliction that has the physical basis for so much dismay and anguish. It is horrible to live with and difficult to die from. Death seldom comes until caused by some other disease. One of the disquieting features of having been in contact with lepers is the long period which may elapse before the disease manifests itself.

Leprosy is not hereditary. Of the hundreds of children that have been taken away from their leprous mothers, not one has developed leprosy.

It is a disease confined to the human race. Just how the transmission from person to person takes place is not known. Experience now warrants the statement that of the lepers who have not had the disease for more than four or five years and are not beyond the period of young adult life, 25 percent can be cured.



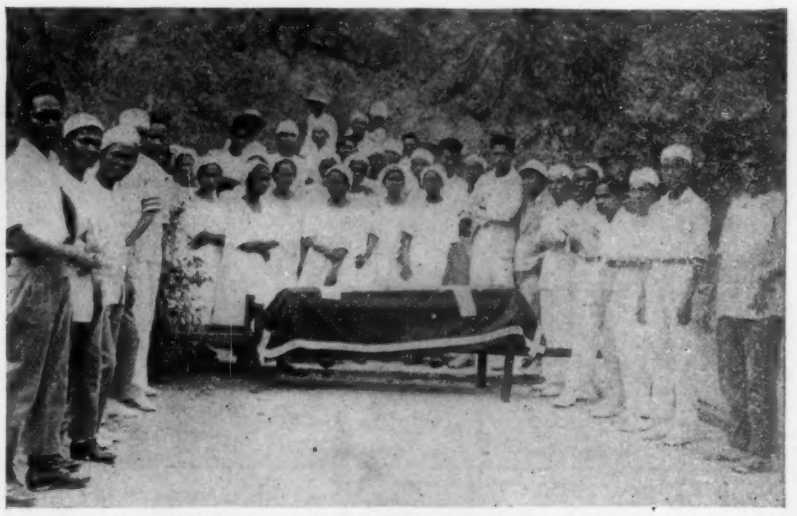
ONE OF THE SIX THOUSAND

The characteristic expression of the leper is one of hopeless resignation

Courtesy of "Asia"

LEPER BAND HELPS TO CHEER COLONY

The members are paid in shoes, hats and a small salary



FUNERAL OF ONE OF THE NURSING AIDES

The aides are lepers who have been trained for hospital work

Drawn by W. M. Butterfield from photographs by Honorary Captain A. G. Dreyfoos, N.Y.F.D.

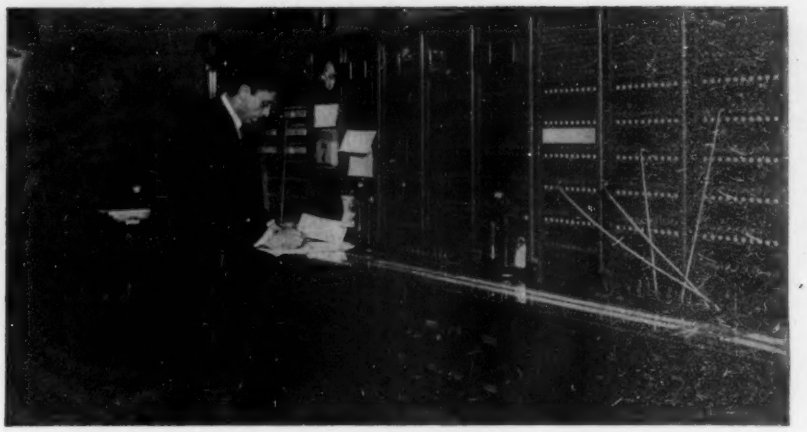
WHAT HAPPENS WHEN YOU "PULL THE BOX"

The time is noon, or "12 M."; the place is 42nd Street and Fifth Avenue, New York. At fire telegraph headquarters the signal is decoded, checked and transmitted to the fire houses: "12 M." has become "12 M. plus 20 seconds." Twenty seconds have been consumed. At a half minute past 12 everything is "rolling." Here is what responds: Engine Companies "65," "21," "26," and "8"; Hook and Ladder Companies "24" and "2"; Water tower "3"; two battalion chiefs and one deputy chief; and the fire patrol maintained by the insurance companies

All photographs by A. G. Dreyfous

RECEIVING THE ALARM

Alarms do not go directly to fire houses. They are received by a dispatcher at a central station on a buzzer and a register tape, and then relayed to the firemen



CHECKING THE ALARM

To avoid error and to provide an adequate response of fire apparatus, the dispatcher quickly but carefully checks his operations before sending the alarm through

On Their Way in Thirty Seconds

How the Speedy and Accurate Transmission of Fire Signals Is of Vital Importance

By Val. Fendrich

Chief, Bureau Fire Alarm Telegraph, N. Y. Fire Department

ON the afternoon of May 10, 1917, a fire in the tower of the City Hall building was reported by telephone. Appreciating the seriousness of the situation, the dispatcher at once sent a call for a full assignment of companies. Immediately after, the Fire Commissioner who happened to be in conference with the Mayor, also telephoned a report of the fire and he was told, without mention being made of a previous report, that the companies would be sent immediately. Imagine the Commissioner's surprise and pride upon finding the firemen arriving almost as he turned from the telephone.

At another time a woman's voice reported by telephone "a fire at 520 Broadway—hurry please." When asked near what street Number 520 Broadway was, she replied "Twenty-second Street." When informed that 520 was near Spring Street and not Twenty-second Street, she became indignant and replied: "520 is next to the Strand Theatre—I think I ought to know where I live." This complicated the situation further as the Strand Theatre is near Forty-ninth Street. The dispatcher thereupon called the telephone company to trace the call and soon learned that it originated in Bayonne, New Jersey. The lady was informed that she was talking to fire headquarters in New York and not her own town's department.

Such are two of the interesting stories, which may be told by the hundred, of curious happenings in the realm of the municipal fire alarm.

The great majority of people take the coming of the firemen as a matter of course and have never concerned themselves with the invisible, but eternally vigilant agent which performs this highly important function. Few are acquainted with the very elaborate telegraph plant which each city maintains, at great cost, in order that the existence of fires may be reported with accuracy and dispatch.

The Nerve System of a City

The fire alarm system of a city is the connecting link between the persons who discover a fire and the firemen who extinguish it. A fire alarm plant has very properly been likened to the nervous system of the human body. It is as vital to a fire department as the nervous system is to the body.

Let us consider the things which go to make up a complete fire alarm plant in a large city or town. In the first instance we find fire alarm boxes installed on wooden poles or in cast-iron posts. These boxes are usually located at street intersections and are placed with regard to the character of the property to be protected. Generally speaking, the boxes are so arranged that the distance between them makes it unnecessary, in developed sections, to travel more than 500 feet from any point to the nearest fire alarm box. The box is an electro-mechanical device for interrupting the flow of current through an electrical circuit that connects the box with a central alarm-receiving station. The interruptions in the current flow are not set up, however, until the box is set in motion which is usually done by the turning of a handle on the door of the box or by the pulling of a hook after the front door of the box has been opened. The disturbances set up in the circuit by the operation of the box are manifested instantaneously at the central station where dispatchers are constantly alert to detect and decode them.

Each fire alarm box is given a number and no two boxes are designated by the same number, from which it follows that the number assigned to a box must represent a definite location. Setting a fire alarm box in motion causes the number of the box to be telegraphed to a central station and the dispatchers at the central station in turn cause the number received to be telegraphed to the fire fighting force where it is received in the engine houses on bells. The firemen then respond to the location represented by the number in accordance with a prearranged assignment of fire companies.

Let us picture, if we can, what happens in a central station when a fire breaks out. All is quiet save the tick of the clock. Three or four men are sitting or standing at different places in the room when suddenly all are called into action by an intermittent buzzing sound scarcely audible to the ear of anyone except the trained dispatcher. One man may be seen quietly but rapidly getting to the place at the relay board from which the buzzing is coming. He eagerly scans a register tape which is recording the incoming alarm, and checks it against the signal

THE TRANSMITTER CONTROL SWITCH

Fire alarms are coded signals. Each signal requires an individual perforated metal card. The card, operating with the control switch, makes the signal that is sent by the automatic transmitter

CHECKING A TELEPHONE ALARM

To detect malicious alarms and to check the accuracy of information and locations given, the call is traced to its origin and verified. On the board are various telephone numbers for emergencies

STATIONS	ENGINE COS.	RESCUE CO.	H. & L. COS.	D. C.	C. OF B.	B. T.	W. T.	TO SUPPLY FUEL	From Depot No.	Res. C. of B.	COMPANIES TO CHANGE LOCATION: ENGINE COMPANIES	COMPANIES TO CHANGE LOCATION: H. & L. COS.
788 Fifth Ave. and 42d St.	(65) 21 26 (8)	..	24 2	3	8 9	..	3	.....	.....	7		
	(54) 2 (1) 14 34	1	(4) ..	..	.. ..	..	..	F W 2	3	..	(76-65) (91- 8) (47-54) (31- 1)	(22- 4)
	16 23 19 (72) 39	..	21 ..	..	6 ..	..	..	.....	.....	..	7-14 35-39	16-24 26-16
	40 5 18 3 33 25	..	7 ..	..	3 ..	..	..	.....	.....	..	37-40 67-37 30- 3	20- 7
	44 28 13 20 74 24	..	12 ..	..	.. ..	..	..	.....	.....	..	11-28	5-12

ASSIGNMENTS TO BOX "788"

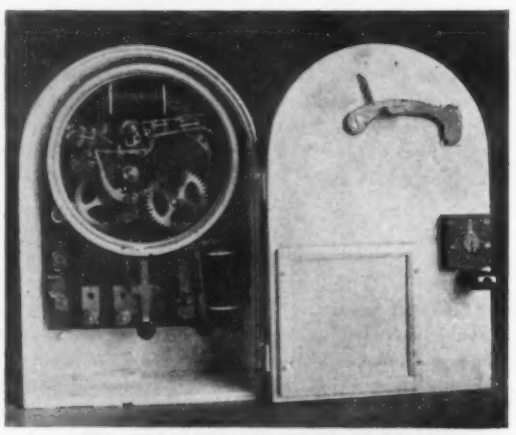
When fire companies leave their quarters the vacated territory must be covered by other companies. This is accomplished by an ingenious system of transfers of apparatus and men which become operative only when a second alarm is sounded. The first line in the entry from the assignment book shows what apparatus goes to box "788" on the first alarm. The second line shows the apparatus responding to a second alarm and the arrows indicate the "move up" of companies to guard the unprotected section of the city

which his ear has detected. He then compares the signal which his ear and eye have noted, with the directory of the particular circuit upon which the signal is being received, to assure himself that the alarm which he has decoded is from an alarm box connected on that circuit. All of these operations are performed in the incredibly short time of ten seconds.

Three means have been employed thus far to insure accuracy but this is not enough. At the very first sound of the buzzer, a second operator may have been observed rapidly taking his place at a receiving board where a flashing lamp gives indication of the incoming alarm. He quickly picks up a plug and cord and inserts the plug in a hole in the board immediately below the lamp, whereupon the record of the incoming signal is produced upon a register tape. While he is listening, he may be seen reaching into a card tray. Suddenly he stops fingering the cards and draws one forth which he reads quickly and compares with a large record pad before him. At the end of the first ten seconds he also has decoded the signal, has found the exact location of the alarm box from which the alarm has been sent, has consulted his records to see that there are companies ready to respond and is ready to give the command to send the alarm to the firemen.

It is too soon, however, to start the transmitting apparatus. One stroke too many or too few may be fatal. So ten seconds are allowed to elapse while both men check their observations a second time as the signal from the alarm box is repeated, each box repeating its signal three times. While all of these operations have been in progress a third man (the transmitter man) has been diligently at work. He has also noted the signal and at the expiration of the first ten seconds he may be seen to draw from a tray a metal card upon the face of which is engraved a number which corresponds to the box number which he has noted. He immediately shows it to the man at the plug and record board who checks the number against what he has received and if both are agreed the metal card is placed in position and locked in the transmitter control switch. All controlling switches are then thrown to their operating positions and the command to start the machine is awaited.

Twenty seconds have elapsed and the stage is all set. The relay board man, the receiving board man and the transmitter operator have consulted and are agreed as to their observations, whereupon the transmitter man is directed to start operation, and the



BOX FROM WHICH ALARM IS SENT

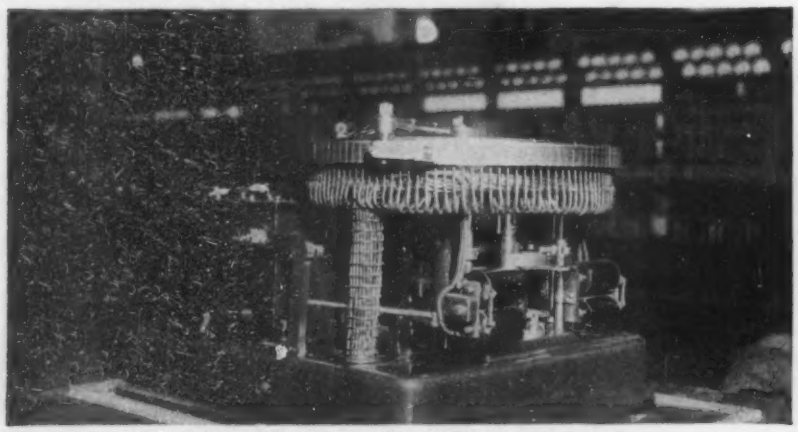
The turning of the outer door handle opens the door and exposes a hook which when pulled starts the mechanism. In some boxes turning the outside handle depresses the hook. The telegraph key within the box is used by chief officers to send subsequent calls

alarm is on its way to the engine companies, where at the end of thirty seconds after the sending of the alarm, the firemen are informed of the fire and its location and are on their way to it.

The handling of one isolated alarm signal is a comparatively simple matter to the skilled dispatchers in the central station, but situations arise at times that try the coolest and most expert of them. The simultaneous receipt of a number of alarms from one district may indicate the outbreak of one serious fire or of several fires. In the first instance only one complement of apparatus should be sent until reinforcements are called for by the officer in charge of the firemen at the fire. In the second instance several complements are required to be dispatched and this sometimes gives rise to complicated situations where special signals are resorted to in order to "fill in" the required number of companies for each location. Or several fires of magnitude may be burning at the same time, each requiring the services of many companies, leaving but comparatively few in quarters to cover a goodly part of the city for any other outbreaks.

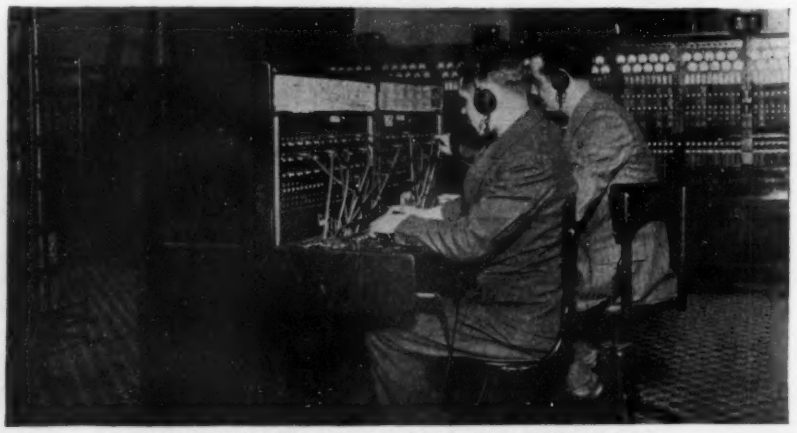
With the rapid and extensive growth of the telephone has come a new agency for sending these alarms of fire. The telephone is a very valuable adjunct to the regular fire alarm telegraph service, but it has its shortcomings and is not so dependable as the telegraph. Having discovered a fire and resorting to the telephone to advise the Fire Department, one is confronted with a number of possibilities for delay or absolute failure. These possibilities, listed in the order in which they occur, are as follows: (1) the telephone may be defective; (2) the telephone central office operator may be slow to answer; (3) the telephone central office operator may err in routing the call through to the fire department; (4) the fire department operator engaged in other work may be slow to answer; (5) the person reporting the fire may be indefinite regarding the location of the fire or actually err in giving the street name or number; (6) the person reporting the fire may be too excited to speak clearly and distinctly resulting in confusion of street name or number and (7) the fireman to whom the call is given by telephone may err in receiving the location of the fire.

The procedure followed in the case of an alarm sent from a regular fire alarm box, which causes fire apparatus to be on its way in thirty seconds, as described, is vastly more dependable than the telephone.



THE TRANSMITTER WHICH SENDS THE ALARM

An electro-mechanical device that sends intermittent current impulses over circuits, causing coded signals to sound on engine house gongs as indicated by the metal cards



THE TELEPHONE SWITCHBOARD FOR FIRE ALARMS

Quick and convenient, but not always reliable for sending in an alarm. In the Borough of Queens, 620 out of 1,355 alarms sent in were received by telephone

The New, or Modified, Form of the Theory of Stellar Evolution

By Prof. Henry Norris Russell, Ph.D.
Professor of Astronomy at Princeton University.
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution.

WE spoke last month of some recent discoveries dealing with the constitution of the stars, and promised this time to discuss their bearing upon stellar evolution. As we start to do so, it will be well to put some of the relations that we shall need to talk about into the form of a diagram, which is far easier to understand than a verbal description. What we want to study is the relation between the real brightness, or amount of heat radiated by the star, and its surface temperature, and we can do this best by plotting them as vertical and horizontal co-ordinates as shown in the drawing, which practically explains itself.

The sun, for example, radiates an amount of heat which we may well take as our standard and has a surface temperature of about 6,000 degrees. It is, therefore, represented by the point marked "The Sun" on the diagram. Sirius with about 30 times the sun's radiation, and a temperature of 10,000 degrees gives the point marked "Sirius." Arcturus, with a radiation of a little over 100 and a temperature about 4,000 degrees, the point marked "Arcturus," and so on.

If we should put on this diagram a thousand stars, instead of the few that are here given, we would find that the points which represent them are very far from being distributed at random. The majority of them would congregate in the neighborhood of the line marked by the points "Typical Star in Orion," "Sirius," "The Sun," "61 Cygni," "Krueger 60," spreading somewhat on each side, but showing a very strong gregarious tendency. These points represent a sequence of stars, beginning with bright, hot stars like those in Orion, and passing through fainter and cooler ones to Sirius, The Sun, and finally to the faint red dwarf stars, like the well-known double stars, 61 Cygni and Krueger 60. This set of stars is called by Professor Eddington the "main sequence."

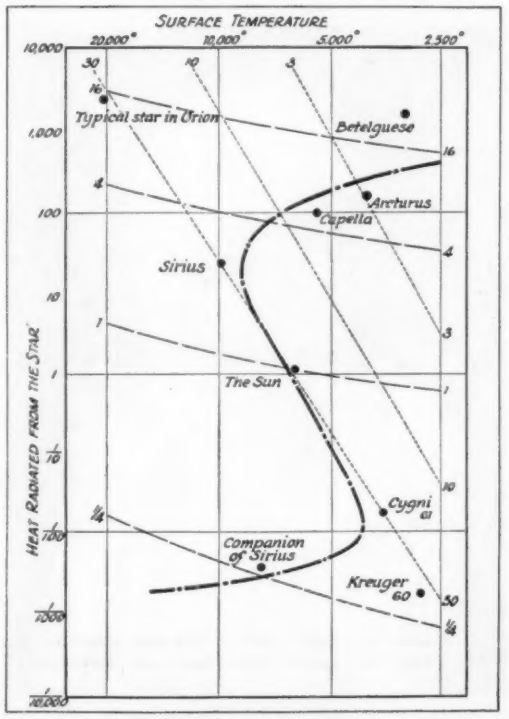
Matter Transformed Into Energy

We would next notice that there were a good many bright red stars, which gave us points like "Arcturus," "Betelgeuse" and "Capella" on our diagram, scattered over a considerable area above and to the right of the diagonal line of the main sequence. These are the giant stars, and if we had enough of them, we would probably find the whole upper right-hand half of the diagram spotted, though with a considerable concentration in the region Arcturus—Betelgeuse—Capella. On the other hand, only a very few stars would give us points on the other side of the main sequence—that is, very few stars are faint and hot. The companion of Sirius, and a few other stars, however, undoubtedly, give us points on this area. These are the white dwarfs. If such stars were not actually so faint, and we could see them at greater distances, we would have many more on our lists. The strong concentration along the main sequence would, however, remain.

Now there is nothing in the theories of Eddington and Jeans, so far as we described them last month, to account for this concentration. A star of given mass—say that of the sun, if of different diameters, will have slightly different brightness and very different surface temperatures, and the corresponding point will be somewhere along the dashed line 1—1. Similarly, stars of other masses will give corresponding lines, like those marked 16, 4 and ¼ in the diagram.

We should expect the bright stars, near the top of the diagram, to have large masses and the faint ones to have small masses; and this is confirmed thoroughly by observation. But nothing in the general theory tells us why the state of a star similar in mass to the sun should be represented by one point on the line 1—1 rather than another. As a matter of fact, all such stars that are known are much like the sun in temperature, and give points not far from the point marked "The Sun" on the diagram.

To explain this, we must recall what has been said in previous months about the source of stellar energy. The only supply great enough to account for the facts appears to involve the gradual trans-



THE "S" CURVE OF THE MODIFIED THEORY

The new scheme of stellar evolution is very much like the old theory and is still more orderly, for we now find a place for the previously puzzling white dwarf stars

formation of matter itself into energy, according to the principle of relativity.

Does this transformation proceed always at the same rate (like radio-activity) or does it go on faster and faster as the temperature rises? Jeans maintains the first opinion; Eddington the second. The arguments in favor of the second view appear to the writer to be conclusive—though too technical to discuss here.

On this view, the internal temperature of the star becomes of great importance, and it is of great interest to enter upon our diagram the lines which indicate a constant central temperature. These are the dotted lines sloping downward and to the right. They are drawn (roughly) for temperatures of thirty, ten and three million degrees. It is at once evident that the central temperature of all the stars of the main sequence is very nearly the same, and about thirty million degrees.

This suggests that, at this temperature, the transformation of matter into energy becomes rapid. If a star was hotter inside than this, more heat would be generated than could escape to the surface. This would force the star to expand, and expansion would lower the internal temperature. Hence, if all the matter inside the star was transformable in this way, it could not get hotter than thirty million degrees at the centre, but would slowly "burn away" its mass—turning it into heat and radiating it away into the depths of space—and would gradually go down the "main sequence."

To account for the giant stars, which have lower central temperatures, we must assume that, in a young star, there are also other kinds of matter which are transformed at a temperature lower than thirty million degrees and, so to speak, serve as fuel for it, and keep it shining for some time—perhaps a long time—in the giant stages before they become exhausted, and the more refractory material is drawn upon.

Again, the white dwarfs lead us to believe that, after the main mass of the star is exhausted, a residuum of intractable material remains, which requires a temperature much higher than 30,000,000 degrees to transform it. When very little except this last stuff is left the central temperature will have to rise and the point on our diagram will leave the diagonal, and pass off again to the left, so that the whole life of a star would be represented by a roughly S-shaped curve.

Life of a Star Many Trillions of Years

How bright a star would be in its giant stages would depend on the mass with which it started; when it would swing off from the main sequence and become a white dwarf, would depend on the quantity of "intractable" material in it; so that the scheme is flexible enough to take account of all the facts. It will be noticed that, as regards the history of an individual star, the new scheme of evolution is very much like the old with the important difference that the white dwarfs usually so puzzling, now find an orderly place at the end of the sequence.

The feeble brightness of the dwarf stars is now attributed to great opacity, which prevents the heat from escaping to the surface, rather than to a lowered central temperature, due to close packing of the atoms—that is all. On the new scheme, the youngest stars are still the huge red giants, like Betelgeuse or Arcturus. The faint red dwarfs, like Barnard's star, are still regarded as near the limit of old age; but such bodies as the companion of Sirius come after them, at the end of the story.

Our last glimpse of a star, therefore, is of a body so greatly condensed that a single cubic inch at its center contains many tons of material, still very fiercely hot inside, and hot even on its surface. As it contracts still more, the time may come when even the fragments of atoms are jammed too close to permit of further shrinkage, and then the mass may begin to cool. Or, perhaps, the dissipation of mass goes on indefinitely, until there is no star left to shine. However this may be, we now think of the life of a star as occupying from birth to extinction, many trillions of years.

The Progress of Medical Science—I

The First of a Series of Four Articles on the Modern Advance in Medicine and Surgery

By Morris Fishbein, M.D.
Editor, Journal of the American Medical Association, and of Hygeia

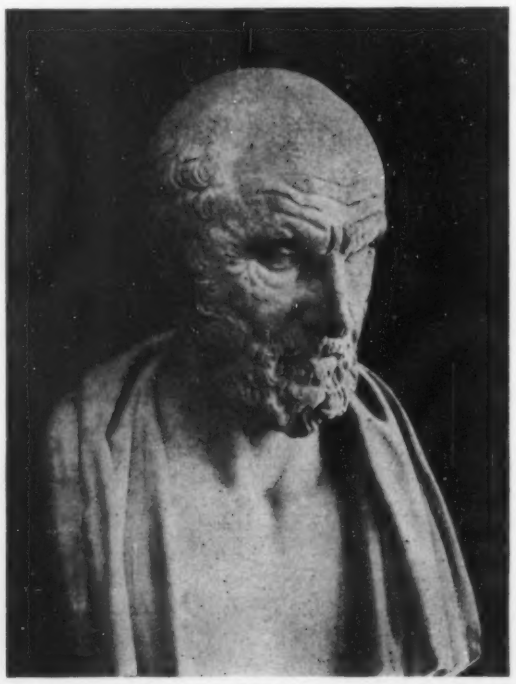
THE medicine of the past was a medley of superstition, faith, theory and tradition, lightened by gleams of accurate observation and logical thought. It was the outcome of a system of study based on trial and error. In the accumulation of three thousand years of medicine from the Edwin Smith and Ebers papyri, which recorded Egyptian medicine, through the records of Hippocrates, Galen, Rhazes and Celsus, there is comparatively little emphasis on what we recognize today as established facts. True, even these ancients recorded certain observations and added somewhat to the sum of actual knowledge, just as Vesalius, Morgagni, Paracelsus, Albrecht von Haller, William Harvey and Sydenham contributed discoveries which modern researches have confirmed as important and true. Even Hahnemann, founder of the homeopathic sect in medicine, while sidetracking medicine for an intricate hypothesis, added greatly to our knowledge of drugs.

Diagnosis An Early Problem

However, in all of these beginnings of medicine there was no systematic search into the unknown, in any way comparable to the stately, steadfast progress of medical science during the last fifty years. That development has carried medicine farther in a half century than it went in the previous fifty centuries. It has laid the foundation for the great public health movements of the past quarter century. It has resulted in the establishment of graded schools with curriculums carefully outlined to convey some part of the vast store of information to prospective students and research workers. It has made an old profession, whose only function was the care of the individual sick man, into a dozen professions which include not only the care of the individual patient, but the study of disease, the prevention of disease, the attack on disease and the care of the sick in large communities, in which diseases spread quickly.

Let us glance first at the sum of medical knowledge previous to the time of Pasteur, for if medicine is to be divided into epochs, the natural divisions must be those before and after the establishment of the causal relationship of bacteria to disease. Much was known of the anatomy of the body, of the bones and muscles and blood vessels that constitute its parts. It was known that human tissues are made up of individual cells.

The microscope had been discovered many years before and human tissues had been studied by its aid. Indeed, medicine was already in possession of certain methods of diagnosis other than merely looking at the patient and taking the history of his illness. Of course, early medicine depended largely on such things as these. Thus, it was that one could diagnose hydrophobia following the bite of a rabid dog from the typical symptoms that had been known for centuries. Scarlet fever was known by the eruption on the skin and other easily observable changes in the body, and syphilis could be diagnosed from the characteristic sore.



HIPPOCRATES
Father of medical science. Of the period about 460 B.C.

There were also weak and abortive attempts to carry diagnosis further through the study of the excretions. One studied the urine, chiefly using inspection, and attempting to associate odd appearances with special diseases. Various forms of pus —good and bad—were described. But this, be it understood, could hardly be called a science of medicine because few things were certain and because one described objective conditions without knowing why things were as they appeared.

A few scientific pioneers were not satisfied, however, to study the diseases of man merely with the natural senses. Laennec had worked out a method for listening to the sounds within the body, and he had classified these sounds in relation to diseases of the organs from which they emanated. Auenbrugger had studied the sounds that occur when the body is thumped, and in a beautifully written thesis, had described the art of percussion. Here were scientific methods for studying disease—scientific in every sense of the word. One thumped the chest over a lung that was consolidated by pneumonia, and the dull sound was the same every time. One listened to a heart in which one of the valves had given way, so that the blood gurgled back; the murmur which resulted was as regular and certain as any other fixed physical process.

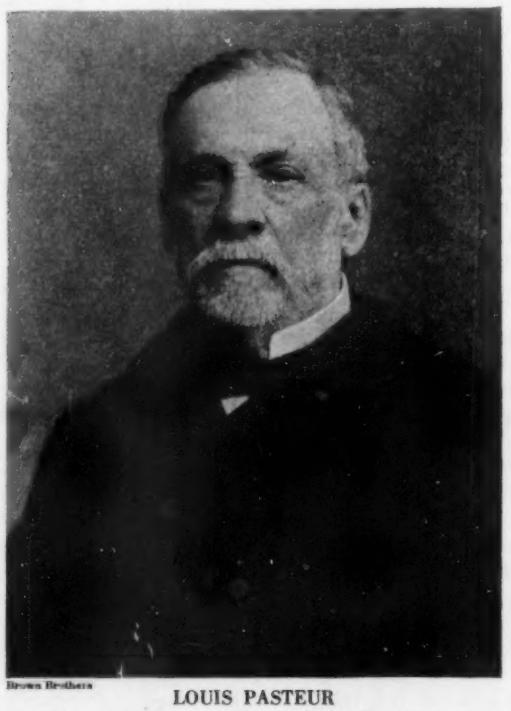
The text books of the period were an unusual conglomeration of the accumulated facts of centuries of accurate observation mingled with the queer hypotheses and unestablished empiricisms of the various writers responsible for them. There was the certain knowledge that quinin would stop the chills and fever of malaria, but not the facts, later shown by Laveran and by Ross that malaria was caused by a plasmodium in the blood and transmitted from one person to another by the mosquito.

Bacteria Cause Disease

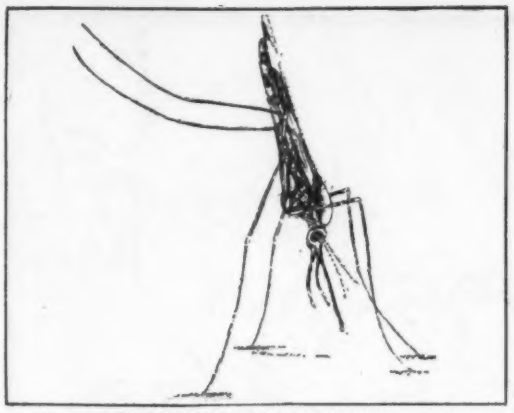
There was the knowledge that mercury could benefit syphilis, but not the statement that syphilis was caused, as shown later by Schaudinn, by a spiral organism transmitted from one person to another. It was known that certain drugs strengthened the action of the heart but it was not known that they brought about this action by affecting the nerve which leads to the heart. Thus, with all the knowledge of the time, there was a mass of theory which was commonly taught to the student as of equal importance with the facts that he learned. The time was surely ripe for a scientist like Pasteur, and particularly ripe for the attitude of skepticism with which he approached the established beliefs of the day.

The credit for the great advances of fifty years ago must be given to several factors: first, a changing conception of disease, brought about by the end-

PAUL EHRLICH
Discoverer of salvarsan, or "606," and founder of the modern science of chemotherapy



Brown Brothers
LOUIS PASTEUR
Founder of the science of bacteriology. He demonstrated the presence of micro-organisms in air



THE ANOPHELES MOSQUITO

This mosquito carries the malarial parasite, which is passed through the body of the female of the species

ing of the theory of spontaneous generation and the establishment of what is sometimes still called erroneously the "germ theory"; second, a beginning application to medical science of the knowledge derived from such fundamental sciences as chemistry, physics, anatomy and physiology; and third, the development of mechanical accessories to the unaided human senses for studying processes within the living human body.

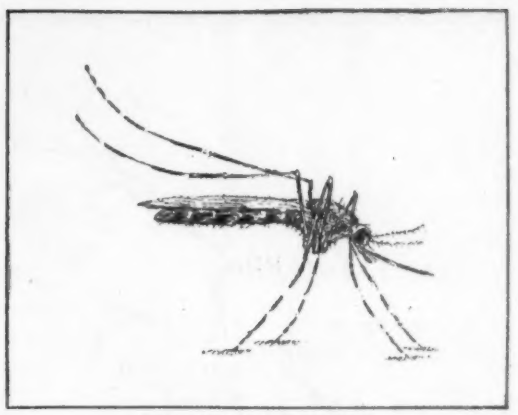
After Pasteur had shown that bacteria do exist and that they cause disease, Robert Koch, German investigator and discoverer of the cause of tuberculosis, established certain laws for determining whether or not any single bacterium was actually responsible for producing any certain disease.
laws include such points, for example, as the demonstration that the organism may be recovered from the bodies of those dying of the disease in pure culture and that the disease may be produced in animals by inoculating them with the organism.

It would be undesirable to tabulate here all of the diseases for which medical science now knows the bacterial cause. They include, however, such condition as tuberculosis, syphilis, diphtheria, scarlet fever, meningitis, typhoid fever, dysentery, pneumonia, lock-jaw, cholera, malaria, anthrax, and a vast number of less commonly known diseases. Hardly a year passes in which new organisms are not isolated and in which obscure conditions are not brought to light. The recognition of this fact is of the greatest importance because it is necessary at this point either to depart from, or to correlate with the demonstrable facts of medical science, the single, narrow theories of disease causation held by various nondescript cultists with limited backgrounds.

If one accepts, for example, the theory of Still, founder of osteopathy, that disease is caused by pressure on arteries, which interferes with the circulation of blood to the organs, one must believe that such pressure, if it has any effect at all, is instrumental in lowering the resistance of the tissues so that the bacteria may attack them. The theory which I cheerfully present to the osteopaths, is beautiful; but unfortunately for osteopathy, there is not the slightest scientific evidence that such pressures actually exist in cases of diseases such as have been mentioned. It may, on the other hand, be demonstrated absolutely that overwhelming doses of virulent bacteria of any certain variety will produce the disease for which the organism may be specific.

Before such demonstrations the theories of cults which believe that there is no such thing as disease, that diseases are due to changing vibrations, or to pressure on nerves, or to wrong diets, or in fact to any such exclusive derangement—before the established observations of scientific bacteriology such theories must, of course, fall by the wayside.

There remain, unfortunately, at this time, a considerable number of diseases which are known to be infectious, and easily transmitted from one human being to another, but for which, as yet, no definite organism has been isolated. Among such diseases are measles, chicken-pox, mumps, German measles, smallpox, epidemic lethargic encephalitis—sometimes called "sleeping sickness"—and a few other unusual conditions. In the study of these diseases science has learned many things: for example, that the blood of a patient with measles put into a person who has not had measles will produce the disease, and conversely, that the blood of patients convalescing from measles, introduced into the blood stream of children who have not had measles, will prevent them from having the disease.



THE CULEX MOSQUITO

This type of mosquito belongs to the household type, and has not been convicted of carrying disease

HIDEYO NOGUCHI

Japanese scientist of the Rockefeller Institute noted for investigations on the cause of general paralysis, yellow fever and other diseases

The Development of Antitoxins

It has, as every one knows, been shown that inoculation with the virus from smallpox pustules will produce smallpox, and that lymph from a cow which has been inoculated, when used as a vaccine in the human being, will cause that person to become immune to smallpox. The attack on disease goes on constantly and at this very time there are several diseases for which causative organisms have been determined, the claims laid before medical science, but not as yet completely and finally established and accepted.

Noguchi, the great Japanese investigator, on the staff of the Rockefeller Institute, has isolated an organism which he asserts is the cause of yellow fever. Everywhere in the world where this disease occurs—and since the magnificent work of Reed, Carroll, Lazear, Agramonte, and Surgeon General Gorgas, that means in relatively few places—scientists are conducting experiments which will either prove or disprove the work of Noguchi.

In the same way, Drs. George F. and Gladys Henry Dick proved that the organism known as the hemolytic or blood destroying streptococcus, a round bacterium occurring in chains, will produce scarlet fever through the injection of a filtrate, prepared from it. With this filtrate they were able to perform a skin test, similar to the Schick test used in diphtheria, which shows whether or not a person is likely to catch scarlet fever if exposed to it. The indications are that this work will be confirmed.

The Dicks, by inoculating a horse with the toxin or poison found in the filtrate from the scarlet fever streptococci, were able to secure from the horse an antitoxic serum sufficiently potent to overcome the poison, as tested out on the human skin with the skin test. At the same time, Dochez and Blake, worked out a method for injecting horses with culture medium into which they then inoculated the scarlet fever bacteria. These bacteria grew in the body of the horse and the animal developed in its blood not only antitoxin for the poison but also antisubstances for other material within the bacteria. Both methods are now used by pharmaceutical manufacturers in preparing antitoxins against this disease.

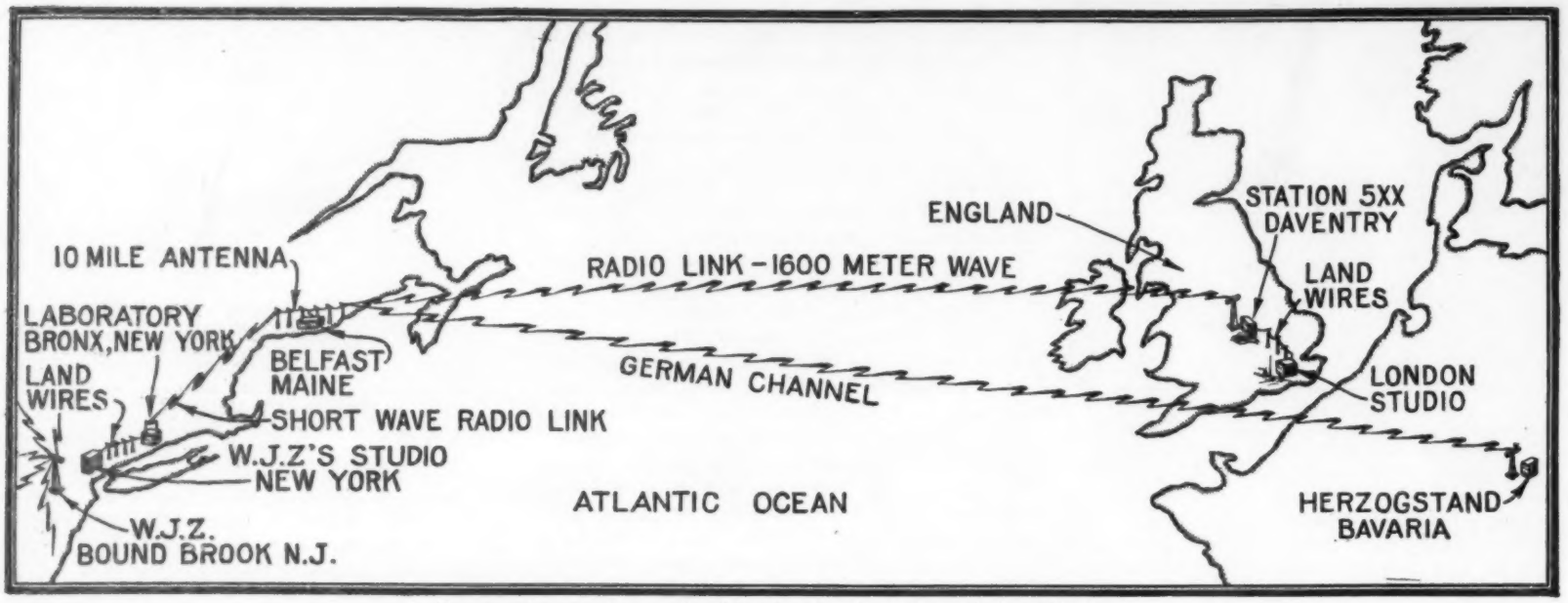
In influenza, Drs. Olitzky and Gates of the Rockefeller Institute have described an organism which they call Bacillus pneumosintes; E. C. Rosenow of the Mayo Clinic has described a green-pigment producing streptococcus, and we have already the Bacillus influenzae described by the German, Pfeiffer. To the uninformed this may seem confusing, but it has been shown beyond a doubt that each of these organisms can produce influenza-like symptoms, and it is conceivable either that one is a mutation or variation of the other, or indeed that such conditions as the common cold, influenza, sporadic and epidemic, and the simple running nose or coryza, may be closely allied diseases due to a variety of closely allied organisms.

But that is theory, and we do not propose to deal in these articles with theoretical considerations!

¶ *In his article next month—the second of this series on The Progress of Medical Science—Dr. Fishbein will trace the recent discoveries of science concerning insulin as well as the importance of the ductless glands.*

WILLIAM CRAWFORD GORGAS

Known to the world as the man who cleaned up the Panama Canal Zone and made possible the excavation of the Panama Canal



Transoceanic route of international broadcasting planned for radio fans this winter

Super-Radio to Span the Atlantic

New and Powerful Broadcasters in the United States, England and Germany Are Ready to Exchange Programs This Winter on an International Scale

By Orrin E. Dunlap, Jr.

ARRANGEMENTS have been completed between American radio impresarios and foreign broadcasting companies for an international exchange of programs this winter by means of super-power. A slight adjustment of American dials will shift the scene from Davenport, out where the corn grows tallest, to the Berlin Opera House, or from Chicago to Big Ben on the House of Parliament, striking Greenwich time. Listeners on the other side of the sea will hear jazz played on Broadway and it is probable that speeches made by President Coolidge will be carried across the Atlantic on waves of super-power. Trinity chimes may be heard on New Year's Eve throughout the Old World and five hours earlier that evening New Yorkers are likely to find themselves in tune with the bells of London, as they herald the arrival of 1926 in the British Isles.

Five super-plants with power outputs ranging from 25 to 100 kilowatts have been built during the past summer. The lofty steel towers and aerials are silhouetted against the skies of three nations, the United States, England and Germany.

America has two stations; one at Bound Brook, New Jersey, is rated at fifty kilowatts and is forty-seven times more powerful than New York's largest station. It is connected by land wires with a studio in New York. The call letters are WJZ. This transmitter will be heard on the 455-meter wave.

The second big station in this country, on the outskirts of Schenectady, is rated at fifty kilowatts. It started tests July 26, on the 380-meter wave. The call is WGY and the experimental signature is 2XAG.

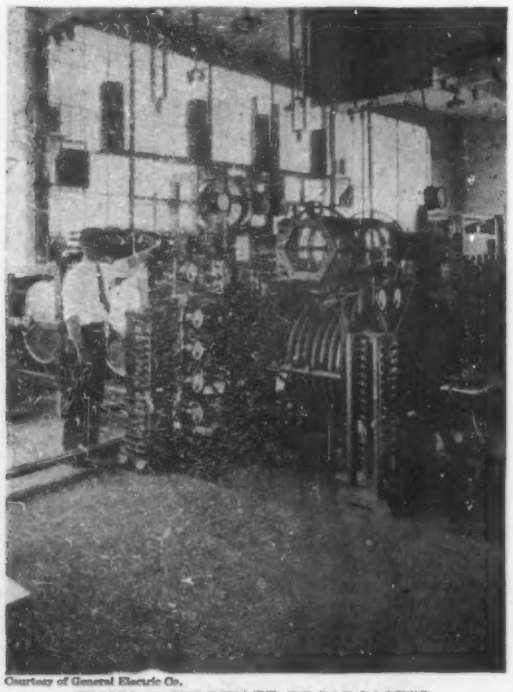
Mountain Peaks Serve as Antenna Masts

England's high-power representative is at Daventry, seventy-five miles from London. It is rated at twenty-five kilowatts but the equipment is designed to handle seventy-five kilowatts should occasion arise. This station has replaced the experimental installation at Chelmsford, used last March in preliminary transoceanic tests. The super-waves of Britain are 1,600 meters in length and they ride through the ether with the call letters 5XX.

The remaining two stations belong to Germany. A 100-kilowatt transmitter, the most powerful in the world, is located at Herzogstand, Bavaria, and the second, a 50-kilowatt installation, is at Koenigswusterhausen.

Special programs played and acted in London will be sent over land wires to Daventry and from that point they will be flashed across the sea to Belfast, Maine, where they will be intercepted and relayed on a short-wave channel, probably 112 meters, to New Jersey and Schenectady, whence the impulses will be highly amplified and rebroadcast from the aerials of WJZ and WGY. The German programs will follow a similar route after their arrival on the Maine coast.

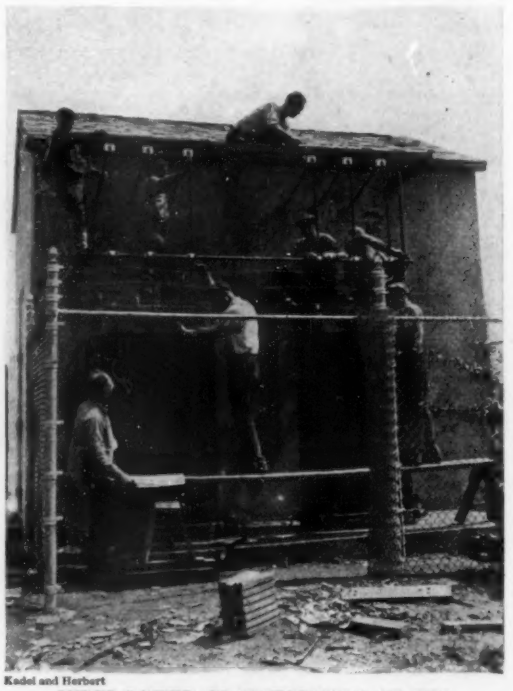
The tops of the Daventry towers are 1,050 feet above sea level. The ground on which the buildings and aerials stand rises 300 feet above the surrounding land, which is all open country. Two masts 500 feet high and 800 feet apart hold aloft a T-shaped aerial, that is, the lead-in wire drops from the aerial and directly underneath is the transmitting station. An overhead telephone line connects the station with the London studio and an underground cable line has been installed to link up with existing



Courtesy of General Electric Co.

WGY'S 50-KILOWATT BROADCASTER

A cage-type aerial connected with this transmitter is held aloft by one mast 300 feet and another 150 feet high. The station is located four miles from the Schenectady studio



Kadel and Herbert

SUPER-POWER TRANSFORMERS OF WJZ

Current for the new 50-kilowatt station at Bound Brook, New Jersey, reaches the station at a potential of 4,150 volts. These transformers step it down to 2,400 volts

Transatlantic

ONE OF GERMANY'S BIG STATIONS

This powerful installation near Berlin serves the whole radio public of Germany, enabling reception by crystal detectors 500 miles away

cables, these cables to be used in case of emergency.

Germany's station at Herzogstand uses an aerial stretched between two mountain peaks. This station will employ a wave over 1,000 meters in length, because the German engineers are of the opinion that 100 kilowatts will not modulate successfully with music and voice on a shorter wavelength. Designers of the station, and the one at Koenigswusterhausen, anticipate no difficulty in spreading the German music and words across the Atlantic, so that they can be detected and reradiated with greater strength, on wavelengths within tuning range of American broadcast receivers. The primary object of these German transmitters is to afford auditors in every nook and corner of Germany radio entertainment even though simple and inexpensive crystal-detector circuits are used. The consistent range will be at least 500 miles in daylight and thousands of miles further at night.

The British Broadcasting Company will select programs of special interest to American listeners and WJZ will radiate feature entertainment from its New York studio for European radio fans. WGY will undoubtedly be linked by wire lines with the microphone in New York. It is planned to exchange concerts several times a week, and if atmospheric conditions permit, perhaps nightly during the winter. Differences in time will be taken into consideration in preparing the schedules, so that listeners will not be required to sit up late at night in order to pick up the broadcasts from oversea. Similar arrangements have been made with the German radio impresarios.

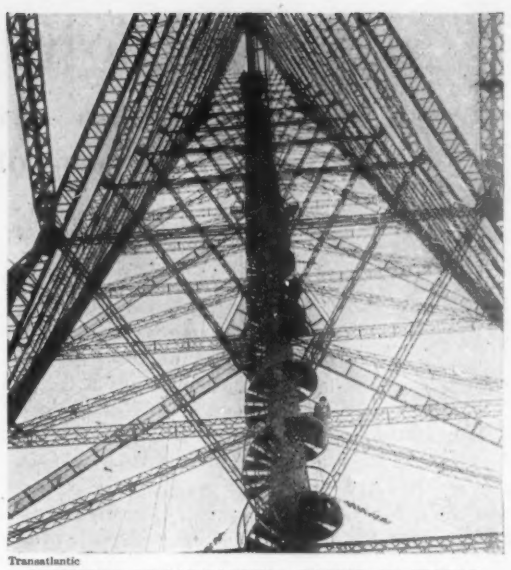
The British engineers will attempt to intercept programs from other European stations, including France, Belgium, Switzerland, Denmark, Spain and Holland, and relay them to the United States via the super-plant at Daventry.

The proximity of Bound Brook to the thickly populated metropolitan district, where millions of radio fans tap the ether, has caused some to express fear that the super-waves will drown out all broadcasts from the less powerful stations. However, it is not likely that the entire fifty kilowatts will be wafted into space at the start, but that the power flowing into the ether channels will be in accordance with the Department of Commerce rules regarding power output and interference. Only an actual test can determine whether or not many of the receiving sets in use today will find it difficult to tune out fifty kilowatts or even ten kilowatts, radiated by a transmitter within a 40-mile radius of the receiving antenna. The super-plant of WGY, 160 miles from New York, has caused no excess interference in the Metropolitan area.

Selectivity of Circuits Must Be Improved

Noted engineers have pointed out that super-power is destined to be the lifeblood of future broadcasting, and that designers of receiving sets will have to improve the selectivity of their circuits. As an example, receivers that worked well in New York three years ago tuned out the stations of those days without much difficulty, but as more transmitters have been built and power outputs have been increased from 100 to 5,000 watts, sharper tuners had to be devised to meet the requirements of new developments in transmission.

Apprehension that a super-power broadcasting system would interfere with the effectiveness of local stations is dismissed by David Sarnoff, Vice-President and General Manager of the Radio Corporation of America, who claims that fears of interference from a super-plant located twenty-five or



Transatlantic

LOFTIEST BROADCASTING TOWER IN WORLD

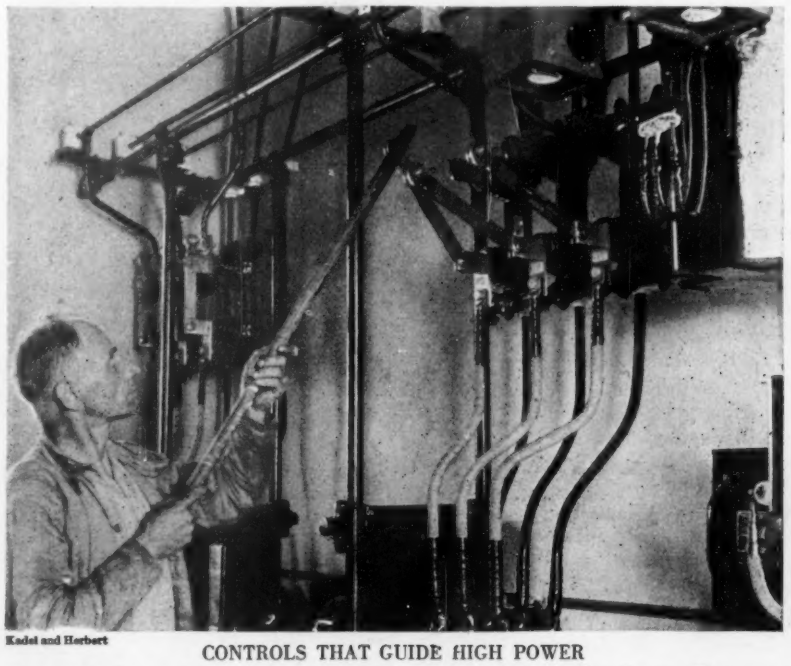
A view through the center of the Koenigswusterhausen tower with its staircase and elevator running up through the center. It is 840 feet high

fifty miles away from a city are entirely groundless.

Mr. Sarnoff supported his contention by saying, "Super-broadcasting will deserve the sanction of the Government, the public and the radio industry itself. There is little question in my mind that once the physical agencies of super-broadcasting are in existence and have proved their value to the public, the radio industry will cooperatively support this agency which is its life-giving force."

Those in favor of super-power point out the benefits to be gained, especially in the summer, when more energy is needed to penetrate the longer hours of daylight and static in order to obtain the same reception in warm July days as in the cold, clear December air. The consensus of opinion of engineers attending radio conferences in Washington has been that nothing should be done to restrict or limit the art of broadcasting, and that super-power should be given a chance to prove its worth. Mr. Sarnoff said that if after a test it was found to be a detriment to radio, because of excess interference, the big station would be scrapped.

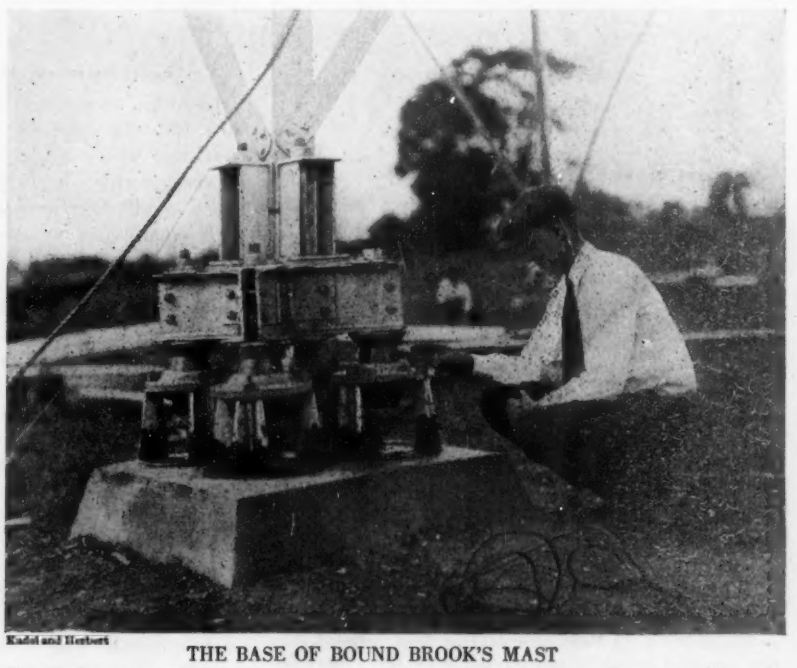
Thus the era of super-power broadcasting with an international exchange of talent is about to dawn.



Kadel and Herbert

CONTROLS THAT GUIDE HIGH POWER

Some of the huge switches of the new super-plant at Bound Brook, New Jersey. They carry a current of 400 amperes



Kadel and Herbert

THE BASE OF BOUND BROOK'S MAST

Big insulators prevent energy from leaking down the steel tower to the earth. Thus the maximum output is used to vibrate the ether

Light Waves or Light Bullets?

Recent Experiments Show that Light Rays Act Like Projectiles in Knocking Electrons Out of Matter. A Revision of the Time-honored "Wave Theory" of Light Is Suggested

By Arthur H. Compton
Professor of Physics at the University of Chicago

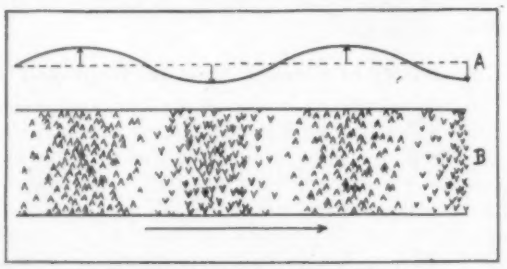
AS LONG ago as the Seventeenth Century, Newton defended the view that light consists of streams of little particles, shot with tremendous speed from a candle or the sun or any other source of light, the sensation of vision being produced by the mechanical impact of these particles or corpuscles on the retina of the eye. At the dawn of the Nineteenth Century, however, experiments were performed which were thought to give positive evidence that light consists of waves. Maxwell interpreted them as electromagnetic waves, and in such terms we have ever since been explaining light rays, X rays and radio rays. We have measured the length of the waves, their frequency and other characteristics, and have felt that we know them intimately. Very recently, however, a group of electrical effects of light have been discovered, for which the idea of light waves suggests no explanation, but whose interpretation is obvious according to a modified form of Sir Isaac Newton's old theory of corpuscular light projectiles or particles.

Einstein and the Photoelectric Effect

When light falls on certain metals, such as sodium, they give off electrons, just as does the filament of a radio tube when heated. This is known as the photoelectric effect. It was to account for this effect that Einstein, about twenty years ago, suggested the reversion to Newton's corpuscular theory of radiation.

This photoelectric effect can be studied especially well with X-rays, which are of the same nature as light though of much shorter "wavelength." X-rays are produced when a stream of electrons strikes a block of metal, just as sound is produced when a stream of bullets from a rapid-fire gun strikes a target. Suppose an electron is shot with a speed of 100,000 miles a second (these little particles certainly move at a tremendous rate). When it hits a "target" of platinum, an X-ray will be produced which may pass, almost undiminished in strength, through a log of wood. But if this X-ray hits one of the electrons in the wooden log just right, it will throw it out at nearly 100,000 miles a second, the speed of the first electron. A most surprising thing for a wave to do!

There was once a sailor on a vessel in New York harbor who dived overboard and splashed into the water. The resulting wave, after finding its intricate way out of the harbor, at last reached the other side of the ocean, and a part of it entered the harbor at Liverpool. In this harbor there happened to be a second sailor swimming beside his ship. When the wave reached him, he was surprised to find himself knocked by the wave up to the deck. Impossible? No more so than that an ether wave should perform this task which an X-ray is found to do!



THE TWO CONCEPTIONS OF LIGHT

In A, the usual conception, the arrows indicate the direction of the electric field. In B, each checkmark represents an individual quantum moving from left to right but capable of producing an electric force at right angles to its motion. The new conception of light fits empirical observations like the usual conception, and therefore does not upset our actual laboratory practice

Brown Brothers

PROFESSOR ALBERT EINSTEIN

He revived the old Newtonian idea of light corpuscles in the form of quanta. It was for this work rather than for his work on relativity that Professor Einstein was recently awarded the Nobel prize

Concentrated Bundles of Energy

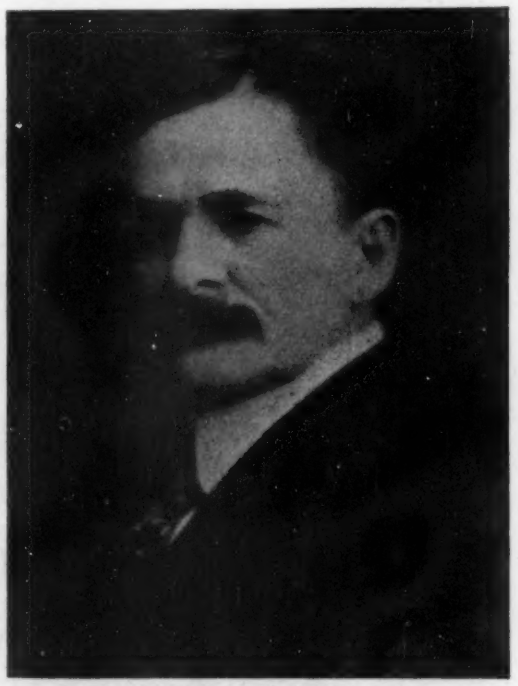
In order to account for this photoelectric effect, then, Einstein suggested that light and X-rays do not consist of waves at all, but of concentrated bundles of energy which he calls "quanta." These quanta shoot in all directions with the speed of light, but each remains an undivided unit. Thus, when the electron strikes the target of the X-ray tube, its energy is transformed into one of these X-ray quanta, which goes out with tremendous speed until it finds an electron to which it can impart its energy. The X-ray quantum spends itself on this electron, which then shoots off with the speed of the first. On this view, a beam of light or X-rays would be less like a ripple in a pond and more like a shower of shot from a shot-gun, each shot representing a light quantum.

We thus have a new picture of light as consisting of streams of little particles. Therefore, a light ray is no longer distinguished by its frequency or wavelength, but by the energy of its quantum. Einstein's relativity theory showed him that due to its energy each quantum would also have a certain definite inertia, or mass. Because of this mass, which is considered the measure of matter, these particles are in the usual sense material, so that we may speak of light as a form of matter. But there is now no need to imagine an ether, such as was necessary to propagate waves, for the inertia of these particles will carry them with undiminished speed from the remotest ends of the universe without any such conducting medium.

The Scattering of X-Rays

Since the idea of light quanta was invented primarily to explain the photoelectric effect, the fact that it does so very well is no great evidence in its favor. The wave theory explains so satisfactorily such things as the reflection, refraction and interference of light that the rival quantum theory could not be given much credence unless it was found to account for some new thing for which it had not been especially designed. This is just what the quantum theory has recently accomplished in connection with the scattering of X rays.

Just as the moon, placed in the path of a beam of sunlight, becomes a source of scattered or diffusely reflected light, so one's finger, placed in the path of an X-ray beam, becomes in turn a source of scattered X rays. If a whistle is blown in front of a brick wall, the echo comes back with the same pitch as the original sound. Similarly we should expect, if X rays are waves, that the X-ray "echo" or scattered X rays should have the same wavelength as the rays which produced them. Spectra, however, prove that a part of the scattered X rays is of distinctly greater wavelength than the parent primary rays. Thus, for each line in the primary spectrum there are two lines in the scattered spectrum, one of the same and the other of greater wavelength than the primary line. This observed change of wave-



PROFESSOR A. A. MICHELSON

The leading exponent of light waves and their uses, and one of America's foremost physicists. It was Professor Michelson's original "Michelson-Morley" experiments on whose results Einstein based his theory of relativity

TRAILS OF RECOILING ELECTRONS

X-rays coming from the right have knocked the electrons nearly in the same direction

length is directly contrary to the predictions of the wave theory.

The quantum theory, however, gives a direct explanation of the change of wavelength accompanying the scattering of X-rays. We now think of the X-ray once more as a little particle which is deflected or scattered when it collides with an electron of the matter through which it passes. If the electron is loose, it will recoil from the quantum which it deflects, so that part of the quantum's energy is spent in setting the electron in motion. Thus, the energy of the scattered quantum will be less than it was before it collided with the electron. But as we have seen, such a decrease in energy of the quantum corresponds to what in the wave theory we call an increase in wavelength, which is just what the experiments show. When a calculation is made on this basis of the amount of the wavelength change, we find exact agreement with the experiments.

The Recoiling Electrons

The part of the scattered rays which have the same spectrum as the primary rays is due, according to this view, to quanta which have bounced from electrons and which are held so tightly by their parent atoms that they are unable to recoil.

In view of the success of the quantum theory in explaining the change of wavelength of the scattered X rays, we look with interest to see whether the electrons that are supposed to recoil from the scattered quanta really exist. When the theory was first proposed, no one had ever observed such electrons. C. T. R. Wilson had, however, developed a method for photographing the trails left by individual electrons passing through air, by condensing water droplets on the ions produced when the electrons shoot through the air, and photographing the droplets under bright illumination. Wilson at once used this method to search for the predicted recoiling electrons, and found indisputable evidence of their existence.

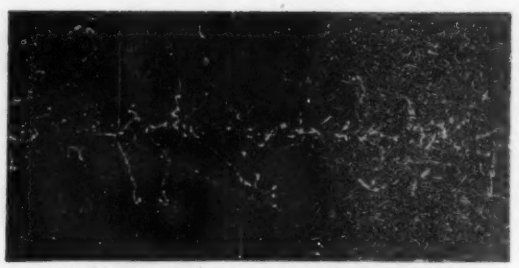
In our laboratory at Chicago we have taken a series of similar pictures, in which the trails of even the shorter type are long enough to measure with accuracy. We find that the number of these tracks, as well as their direction and range, agrees very well with the predicted characteristics of the electrons recoiling from scattered quanta. Since their very existence was unknown before they were predicted by the quantum theory, these recoil electrons must be taken as a strong support of the theory of radiation quanta.

Waves or Projectiles?

We have seen that the spectrum of the scattered X rays is what it should be if the rays consist of little projectiles which have bounced from the electrons in the scattering material, just as one billiard ball bounces from another. Not only this, but we have photographed the recoiling billiard ball, or electron, from which the quantum has bounced. The obvious interpretation would be that X rays, and so also light rays or radio rays (for they are all the same kind of thing) consist of streams of little particles.

The question immediately arises, what then about radio waves? Are there no such things? The answer is undoubtedly yes. That there are electric waves of some sort can be shown directly in the laboratory, where standing waves of brush discharge can be produced along conducting wires. Therefore, there is no reason to doubt but that similar waves go out into space, substantially as the electromagnetic theory states.

An attempt at the reconciliation of these two viewpoints, which seems to be growing in favor, is to suppose that electric waves are not ether waves, but



KNOCKED AT 100,000 MILES PER SECOND

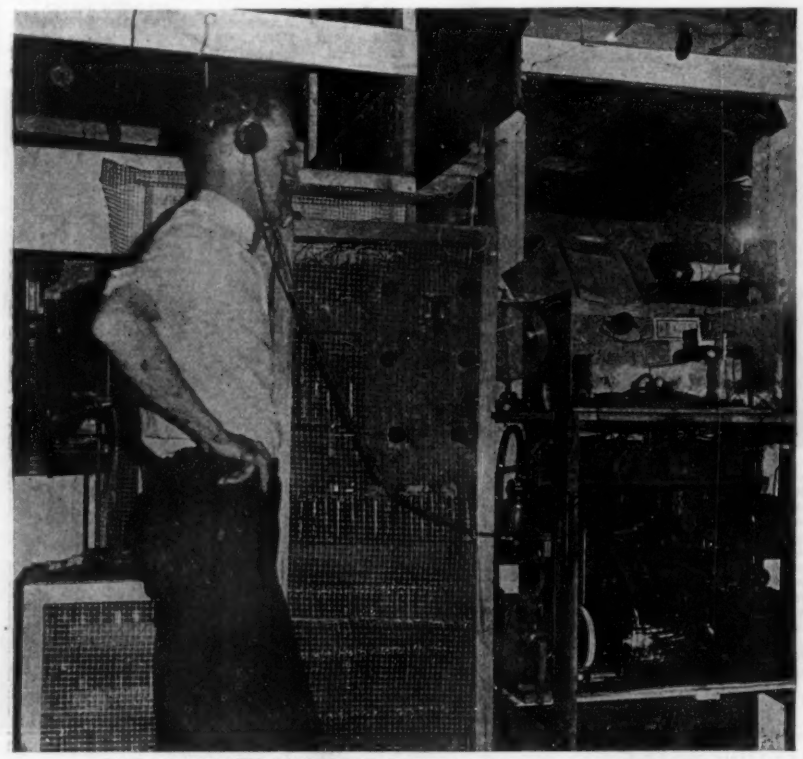
If waves are not like projectiles, how can they knock electrons around like this?

successive sheets of radiation quanta, somewhat as one sometimes sees sheets of drops in rainstorms. Where according to the usual theory the electric field is strong, there will be a concentration of quanta, and these quanta will be moving forward just as the wave does. Also there will be some quanta directed upward and some down, just as part of the electric field in the wave is directed upward and part down. From a 1,000-watt broadcasting station of 300 meters wavelength, it can be shown that, at a distance of 1,000 kilometers, there would be more than 400 such quanta in each cubic centimeter of the wave. Thus, the wave would be to all appearances continuous, though actually made up of discrete particles, just as water seems continuous though made up of molecules.

What Will Be the Solution?

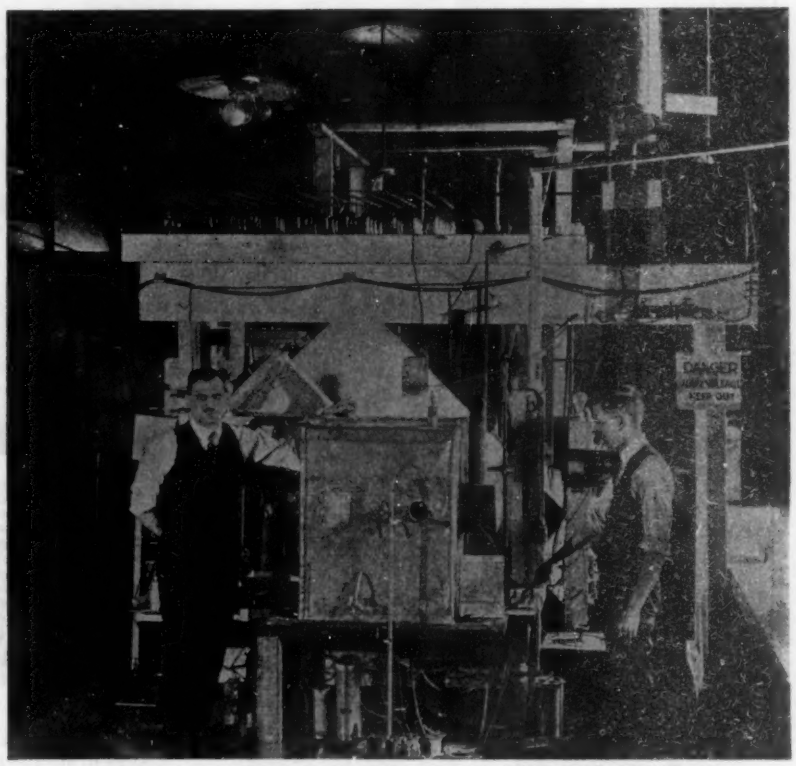
The manner in which we are to reconcile these new ideas with the long established facts of interference and refraction of light is very obscure. A suggestion has been made by Duane which may ultimately lead to a solution, but as yet the way is very dark. It seems that the most rapid advances in the study of the nature of radiation have recently been made by those who have adopted the idea of light corpuscles.

I believe, however, that most physicists look forward to a final solution of the problem of the nature of light in some combination of the wave and quantum theories.



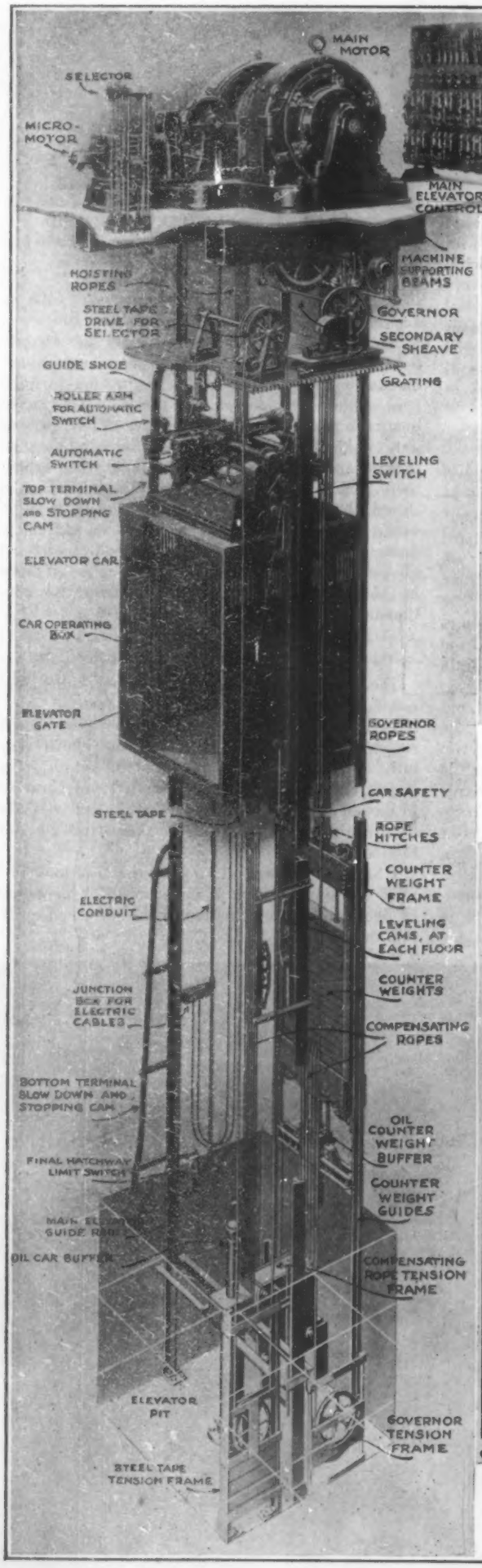
ONE 10,000,000TH MOSQUITO POWER FROM 60 HORSEPOWER

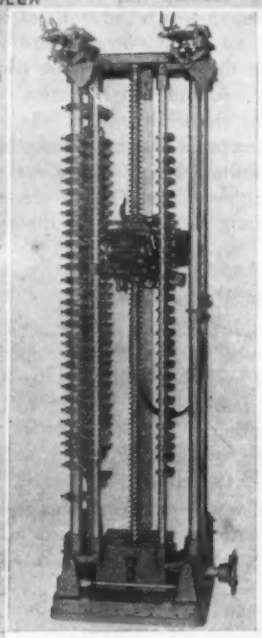
A 40-kilowatt, 200,000-volt transformer producing a single X-ray quantum, amplified three stages and heard as a click in the headset. A mosquito climbing up one inch of screen does the work of 10,000,000 of these X-ray quanta



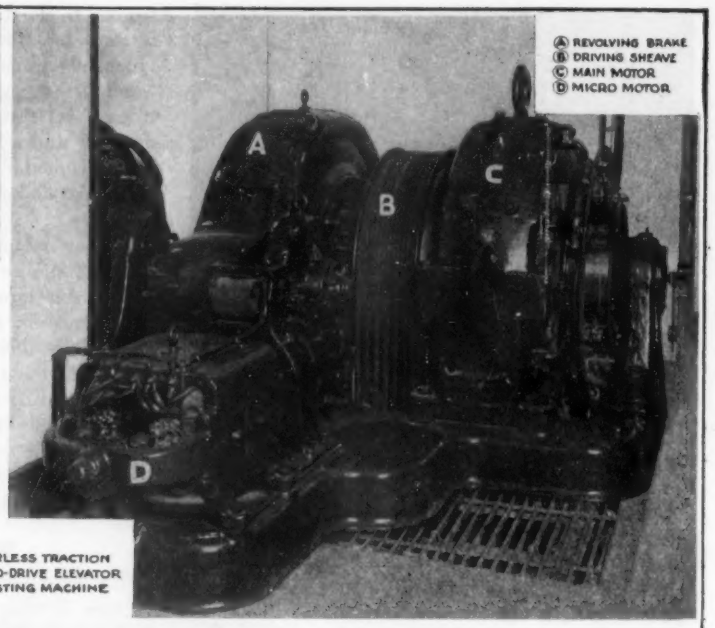
PHOTOGRAPHING ELECTRON TRACKS LIKE THE ABOVE

The chamber in which the electrons are photographed is enclosed in the square lead box in the foreground. The condenser, made of ordinary glass milk bottles which may be seen on top of the apparatus, supplies the illuminating sparks for taking the photographs



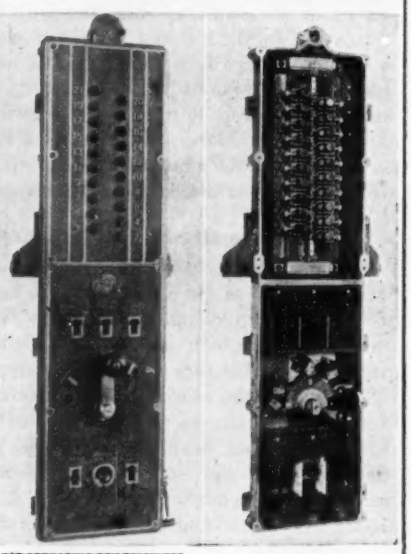


SELECTOR MACHINE AUTOMATICALLY GOVERNS THE SLOW DOWN AND STOPPING OF THE CAR



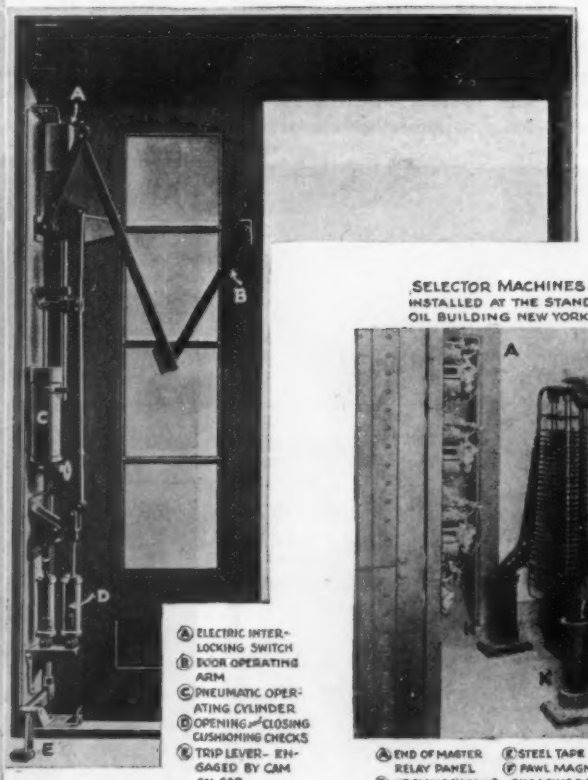
GEARLESS TRACTION MICRO-DRIVE ELEVATOR HOISTING MACHINE

TYPICAL FLOOR LANDING SHOWING UP AND DOWN CALL BUTTONS AND WAITING PASSENGER SIGNALS



CAR OPERATING BOX COMPLETE
(A) SAFETY SWITCH (E) CLOSE DOOR
(B) SLOW SPEED (F) OPEN DOOR
(C) NON-STOP (G) MICRO
(D) START (H) CAR LIGHTS
(I) EMERGENCY CUT-OUT

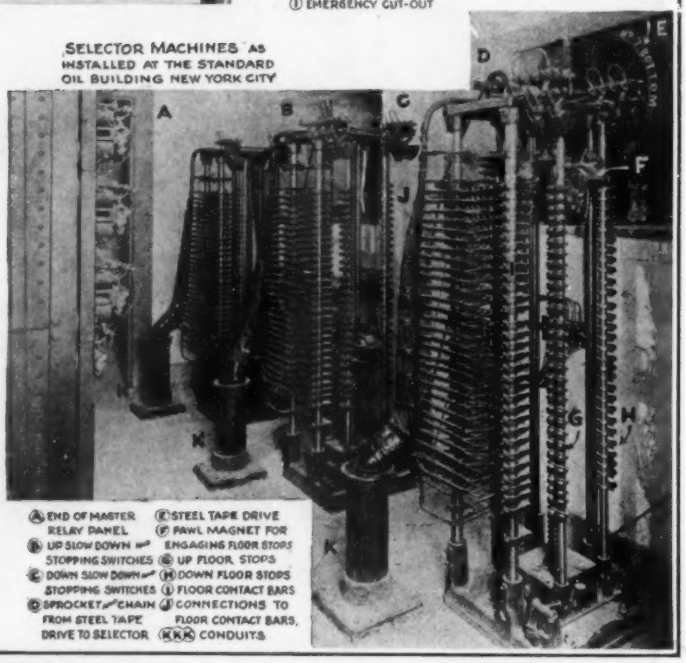
CAR OPERATING BOX WITH COVER REMOVED



(A) ELECTRIC INTERLOCKING SWITCH
(B) DOOR OPERATING ARM
(C) PNEUMATIC OPERATING CYLINDER
(D) OPENING AND CLOSING CUSHIONING CHECKS
(E) TRIP LEVER—ENGAGED BY CAM ON CAR

PNEUMATIC DOOR OPERATOR

SELECTOR MACHINES AS INSTALLED AT THE STANDARD OIL BUILDING NEW YORK CITY



(A) END OF MASTER RELAY PANEL
(B) UP SLOW DOWN AND STOPPING SWITCHES
(C) DOWN SLOW DOWN AND STOPPING SWITCHES
(D) SPROCKET AND CHAIN FROM STEEL TAPE DRIVE TO SELECTOR
(E) STEEL TAPE DRIVE
(F) PAWL MAGNET FOR ENGAGING FLOOR STOPS
(G) UP FLOOR STOPS
(H) DOWN FLOOR STOPS
(I) FLOOR CONTACT BARS
(J) CONNECTIONS TO FLOOR CONTACT BARS
(KKK) CONDUITS

SPEEDING UP ELEVATOR SERVICE

At the left will be seen the complete mechanism of a modern high-speed elevator for intensive service. It stops automatically at a desired floor through the pressing of a button. It opens and closes the shaft-door and car-gate automatically by compressed air, and stops exactly level at the floor. The elevator "operator" is no longer an operator at all, he is simply a guard, initiating the starting of the car. A steel tape secured to top and bottom of the car serves to actuate a miniature dummy elevator in the selector, which runs up and down with the car, giving the necessary electrical orders to the obedient machinery. The whole system is as completely automatic as it seems possible to make an inanimate thing.

Elevators With Electric Brains

By Albert A. Hopkins

THE "vertical" railway has been with us for many years, passing through various stages of evolution, from the slow-moving elevator operated by rope-pull to the high-speed, automatic, signal-control elevator, operated by pressing buttons in the car and hall. As buildings grew in size, greater and greater demands were made upon the elevator builder. Land values have increased enormously in later years and increased land values mean higher buildings and higher buildings mean more space taken by the elevators in order to serve the transportation requirements of the building. This presents a very serious problem to the architect, as the building must have a large percentage of rentable space in order to make it profitable to its owners. Therefore it is necessary to "speed up" and get the highest possible service out of each elevator, to reduce to a minimum the number of elevators required.

Until a few years ago a speed of 600 feet per minute was an exception, but today, speeds of 800 feet per minute or more are perfectly practicable due to marked improvements in elevator control.

The Otis Elevator Company have recently brought out two signal advances, the micro-drive self-leveling elevator, and the automatic signal control. These two inventions have made possible the automatic electric elevator we describe.

Jockying Automatically Eliminated

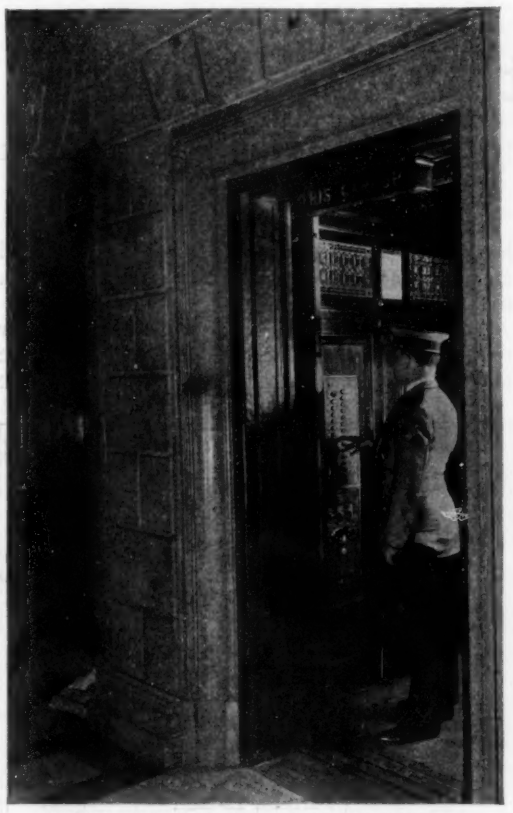
Due to the high speeds previously noted it is very important to provide an efficient and reliable safety device capable of stopping a fully loaded car. This device is located under the car and is connected to a speed governor located at the top of the shaft. In case the car attains excessive descending speed, the governor is tripped and grips the governor cable, causing a drum which is mounted in the safety frame to revolve, which in turn operates right and left-hand screws, forcing wedges between the guide clamps and causing heavy steel jaws to grip the guide rails, bringing the car to a smooth and gradual stop.

Probably you have often wondered why the elevator car as it approaches the terminal landings, gradually slows down without any action on the part of the operator. This is accomplished by the automatic "slow-down" of the motor which is controlled by a multiple contact switch on top of the car, which switch is gradually actuated by curved cams located at top and bottom of the shaft. Oil buffers are also provided to bring the car to a gradual and positive stop at the extreme limits of travel beyond the terminal landings, should the car run past for any reason.

Now, consider the new devices which have done so much to speed up elevator service, and which also make for safety. For years we have been told that the elevator is under the control of the operator at all times. Now, we reverse this and can truthfully say that the elevator is under the control of a machine at all times, and a very clever machine it is too.

The "micro-drive" differs from the ordinary method of operation in that it always automatically brings the car level to the landing, and maintains it there entirely independently of the operator. It not only entirely eliminates the tripping hazard but also saves time and power, as the operator is not required to "jockey" or "inch" to make a landing. This drive is very advantageous for all passenger elevators but it is practically indispensable for express passenger service, as well as for freight and hospital elevators.

This machine is usually equipped with two motors instead of one, the leveling motor having only about one-tenth the horsepower of the main motor. There are two brakes, one for stopping the leveling-motor and one for stopping the main motor. The second brake also serves as a friction clutch to connect the micro-drive to the hoisting drive. Both motors are mounted together as a unit on a bedplate. The leveling-switch on the car may be considered the car switch and the leveling-cams at each floor may be considered as the operator. While the car is being run by the main motor, the leveling-switch operating-rollers are pulled out of reach, and will pass clear of the hatchway leveling-cams. However, while the elevator car is slowing down, on approaching a designated landing, and is in the micro-zone, the leveling-switch is automatically released to engage the leveling-cams. The entire mechanism



PREARRANGING HIS PASSENGERS' STOPS

The elevators of the Standard Oil Building in New York City have the new "signal control" system by which the stops are made automatically. The attendant only initiates the starting of the car and serves as a guard

works so rapidly and smoothly that the passengers in the car do not realize what is being done for their comfort, convenience and safety.

The second interesting feature is the automatic signal control. This system has been designed especially for automatic control of high-speed elevators, thus saving time, and giving smoother operation and absolute obedience to signals. Signal control may be used for any number of elevators, and the name "signal control" is given because the waiting passengers at a landing actually stop the car, instead of signaling the operator to do so. All that the operator is required to do is to initiate the starting of the car, and to act as a guard, similar to the guard on the subway train; even the doors being arranged to open and close automatically without any effort on his part.

At each intermediate floor there are two stopping buttons controlling all cars, one for the "up" direction and one for the "down." There is also provided at each intermediate floor an "up" and "down" signal lamp for each car. A car is stopped at a floor by the waiting passenger pressing a button at that floor, or by the operator pressing buttons in the car-operating box, as floors are called for by passengers in the car. When the operator receives a signal from the dispatcher to start the car, he moves a small switch handle which causes the power-operated car gate and shaft door to close. The instant they are closed, the car automatically starts and proceeds on its journey, until it approaches the first landing for which a button has been pressed, either in the car or at the landing, when it automatically slows down and stops level with the landing. The car-gate and shaft-door open automatically while the car is leveling. After passengers leave or enter the car, the operator again moves the small switch handle, causing the gate and door to close, and starting the car. The car will automatically stop in proper sequence at all floors for which the car buttons have been pressed, regardless of the numerical order in which they were pressed.

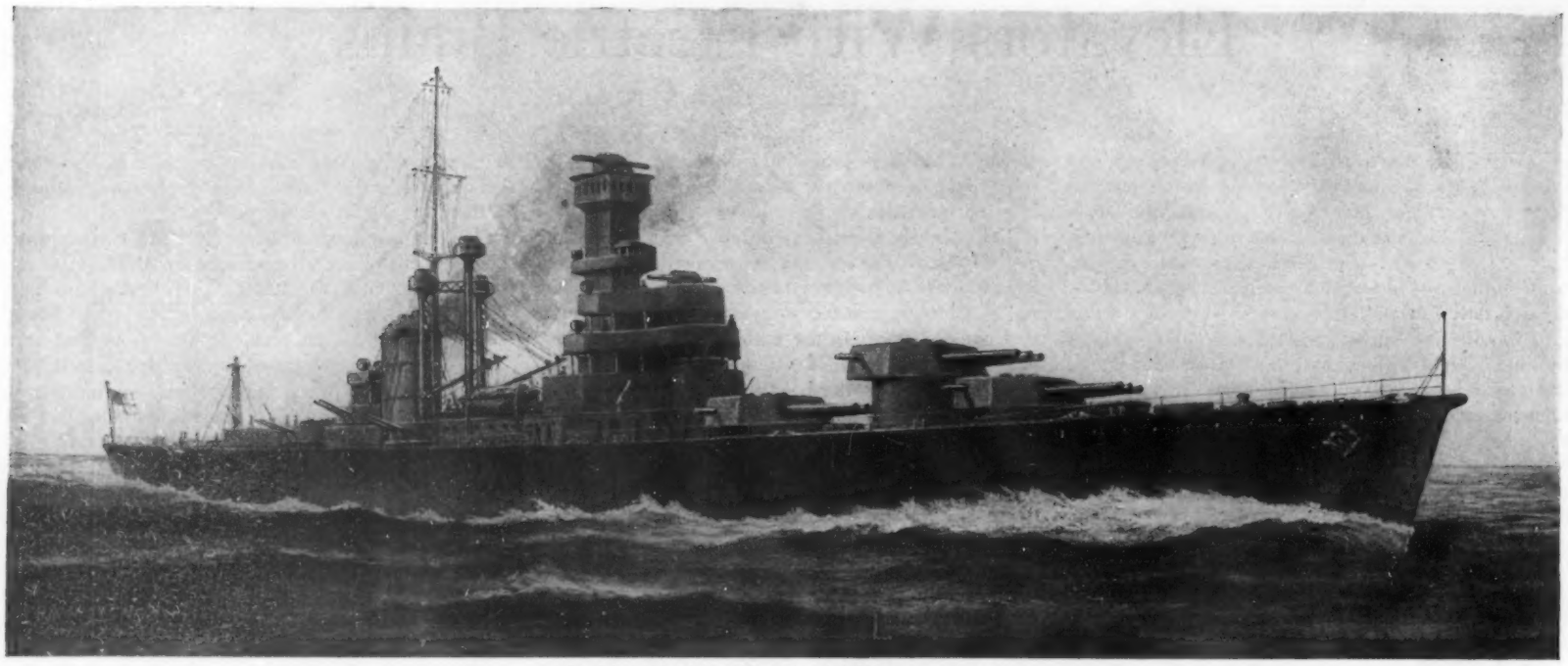
Dummy Car Does All the Work

The selector is an interesting mechanism, but difficult to describe even with the aid of the illustrations. It is shown in the center and in the lower right-hand pictures. The selector is positively driven from the car by a steel tape, through reduction gearing, causing the movable contacts on the selector to travel accurately in a direction corresponding to the car, but at a very much slower speed. The stops of an elevator are controlled by its individual selector. The stops registered from within the car are controlled by the car-operating buttons, in conjunction with the selector. The pressing of the hall buttons are registered by the magnetic relays on the master panel, which automatically distributes and transmits the calls to the various selectors. The selector of the nearest car approaching a particular landing will cause that car to stop at that landing.

These contacts at each floor-position are engaged by traveling brushes carried by the crosshead. These brushes and contacts work through magnets and relays, thus initiating the stopping and starting of the car. The latching magnets on the master relay panel in conjunction with the selector brings about the automatic stopping at the floor.

To go into the intricacies of the connections would take us too far afield. What it is desired to explain is the broad fact that the steel tape runs a miniature substitute up and down the selector-frame and this dummy car does all the work, transmitting its orders through the relay and panel boards to the micro-motor and keeps up the flashing of the lights at the signals on the floors where elevator service is required.

With signal control, after a passenger has pressed a hall button, the nearest available car will always respond to the call, which everyone knows is not always the case with the old-fashioned method of signaling to the operator in the car. Such stopping is dependent upon the whim of the operator or the knowledge that the signal has been given.



"H.M.S. NELSON" TO BE COMPLETED IN 1927
This ship and her sister the Rodney *will replace four of the older British battleships*

New Treaty Battleships "Nelson" and "Rodney"

The British Interpretation of the Lessons of the Jutland Battle

By Hector C. Bywater

BRITAIN'S new battleships, *Nelson* and *Rodney*, are now approaching the launching stage, and both will go afloat before the end of the year. Naval experts the world over have long displayed a lively interest in these ships, due to the rumored novelties of their design. They are known to incorporate all the modifications suggested by war experience, and especially by the Battle of Jutland, so far as this has been possible within the limits of displacement and gun-power dictated by the Washington Naval Treaty.

Interest has been further excited by the reticence of the British Admiralty, which, up to now, has declined to release any information about the ships beyond their principal measurements. This policy of secrecy has had an unfavorable reaction abroad. It has given a handle to publicists and agitators who pander to anti-British sentiment, and these people have contrived to generate a suspicion in the United States that Great Britain is deliberately flouting the technical clauses of the Treaty by endowing her new battleships with unauthorized powers of offence.

Not Airplane Carriers

But a simpler and more convincing reason for the Admiralty's "hush" policy might be advanced. It is conceivable that the British naval chiefs, regarding as their exclusive property the hints on ship design which they acquired during the war, are not disposed to share this invaluable knowledge with other countries that did not pay the same price for it. Such an attitude is natural enough, for the British Navy unquestionably bore the brunt of the struggle at sea, and had far heavier losses than were suffered in the aggregate by all the other naval forces associated with it. Nor should it be forgotten that the United States naval mission which visited Europe after the war was allowed to inspect all the latest ships, including the then unfinished *Hood*. An American officer who made that tour of inspection has assured me that nothing whatever was withheld from the cognizance of the visitors by the British naval authorities.

In the case of the new battleships a closer reticence has been observed; but while the fact may be open to criticism on political grounds, it certainly does not justify the allegations of bad faith in regard to the Treaty, which have been made so freely by certain writers in the United States. It has now become possible to furnish some information relating to the "Nelson" design which, although not official, may be accepted as reliable. As will be seen, these details completely refute charges preferred by American critics to the effect that the ships are camouflaged aircraft-carriers.

Dimensions of the *Nelson* and *Rodney*

Length overall	702 feet
Extreme breadth	106 feet
Normal draft	30 feet
Standard displacement	35,000 tons
Armament	Nine 16-inch guns in three 3-gun turrets Twelve 6-inch guns in six 2-gun turrets Numerous anti-aircraft pieces
Armor: (Probable)	Turrets, 13-inch Belt, 12-inch Heavy deck protection, particularly at the forward group of 16-inch turrets
Speed: (Probable)	23 knots

Voted under the Navy Estimates for the fiscal year 1922-23, both ships were laid down on December 28, 1922—the *Nelson* by Armstrong, Whitworth and Company, at Newcastle-on-Tyne, the *Rodney* by Cammell Laird and Company, at Birkenhead. Industrial troubles have delayed their completion, and, if launched in the coming fall, they will have been on the stocks the better part of three years. They are scheduled for delivery some time in 1927.

Their leading dimensions are: length 702 feet over all, extreme breadth 106 feet, normal draught 30 feet, standard displacement 35,000 tons. This last figure refers to the weight of the ship as complete in every respect, but without fuel or reserve feed water on board. When these items are added, the gross displacement will be nearer 40,000 tons. The form of hull resembles that of *H.M.S. Hood*, with the same clipper stem, a cut-away stern, and sides falling inward to minimize the chance of direct hits. Unlike the *Hood*, however, bulge protection is not fitted as an external element, but is incorporated as an integral part of the ship's structure.

Not High-speed Ships

From the dimensions given, which are official, it is clear that the "Nelsons" have not been designed for very high speeds. What they can do in the way of speed is still confidential, but it will be surprising if they prove to be much swifter than the 22-knot "Royal Sovereigns." In other words, they are battleships pure and simple, with no pretensions to the high mobility of battle cruisers.

Their main armament has been a more or less open secret for some considerable time past. It consists of nine 16-inch guns, each weighing about 106 tons, and probably akin in ballistic properties to the American piece mounted in the "Marylands." Following the *omne ignotum pro magnifico* rule, some foreign publications credit the British 16-inch gun with a length of 50 calibres, but this is almost certainly incorrect. Very long guns do not seem popular in the British service, which has only once employed a 50-calibre gun of large bore, namely, the 12-inch Mark XII. mounted in the "St. Vincent"

and "Neptune" ships, and then with qualified success.

The nine 16-inch guns of the *Nelson* are carried in triple turrets, so that Great Britain, after many years of hesitation, at last falls into line with the United States and Italy, the pioneers in this type of gun mounting. It is, of course, a compromise, for regarded as a unit a gun mounted singly is more efficient than as one of a pair, and for rapid fire a two-gun turret is equal to one of three guns.

Ammunition supply and loading operations are complicated by the three-gun mount, while the deflection set up by the firing of the outer guns has to be corrected by a very delicate and not always infallible system of synchronized discharge. The subject, however, is too large to be explored further on this occasion. Suffice it to say that when the pros and cons are nicely balanced, the three-gun turret tips the scale by reason (1) of its economy in weight, and (2) its adaptation to other tactical requirements, which will be dealt with later.

The triple turret is no novelty, save in the British service, but the really striking feature of the "Nelson" class is the disposal of the turrets themselves. Contrary to all precedent, the guns are grouped together in the forward part of the ship, leaving the after section denuded of heavy armament. The first and third turrets are on a level, the second being raised on a high barbette. This enables six 16-inch guns to fire directly ahead, leaving the other three guns to join in as soon as the target bears a few points on either beam. Over a fairly wide arc on either broadside all nine guns have an unrestricted field of fire. But if an enemy ship were astern, or bearing several points abaft the beam, it could not be brought under fire from the big guns. From the tactical viewpoint this is unsatisfactory, if only because guns should not be mounted on the assumption that the target will always be in a given position and never stray into one of the "blind spots" or neutral zones outside the field of fire.

Reason for Concentration of Turrets

When Beatty made his famous 16-point turn at Jutland, racing ahead of the German battle cruisers to lure both them and their oncoming battle fleet into the arms of Jellicoe, his big guns could not have fired a shot had they been disposed on the principle adopted in the "Nelson" class. With this object lesson before them, it seems odd that the Admiralty experts should have decided to sacrifice stern fire altogether.

That they did so was in deference to another and perhaps still more important lesson learned at Jutland: that the really vulnerable points of a capital ship are its turrets, barbette trunks, and contiguous magazines. At least two out of the three British capital ships lost in that engagement were sunk by shell that pierced the turret walls or roof and transmitted a flash to the powder rooms. In the case of the third ship, the *Indefatigable*, there is reason to suppose that projectiles, striking just below the upper deck level, penetrated one of the barbette trunks and so gained access to a magazine.

Other ships that came within an ace of destruction through turret hits were the British *Lion* and the German *Derfflinger* and *Seydlitz*. It would seem, therefore, that the most vulnerable part of a capital ship is no longer the waterline but the gun positions. The effect of hits betwixt wind and water may be localized by sub-division; but if a shell penetrates to a magazine, or even transmits a tongue of flame that far, the whole ship is placed in deadly peril.

It was in order to avert this calamity that the grouping of the main armament on the forward deck was decided upon for the "Nelson" class, since it makes possible the concentration of very thick armor on the turrets and barbettes themselves, as well as on the waterline and topsides in way of the gun positions, and the fitting of stout protective decks over this particular area of the ship.

Although the actual strength of the vertical and horizontal armor to be fitted is not disclosed, these ships will probably be the most heavily-plated vessels afloat. This feature alone serves to indicate how wide is the gulf that divides current British practice in capital ship design from the principles enunciated by Lord Fisher, who had little use for armor and pinned his faith to big guns plus speed —a combination that failed to make good in the fiery test of Jutland. Admiral von Tirpitz's dictum, "The first requirement of a fighting ship is that it shall remain afloat under fire," evinced a shrewder appreciation of actualities.

That Airplane-Carrier-Battleship Myth.

The man who set going the rumor that the new Treaty battleships, *Nelson* and *Rodney*, were to be camouflaged airplane carriers, combining a powerful battleship and a huge airplane carrier in one, was possessed at once of a perfervid imagination and a ludicrous ignorance of the simplest elements of warship construction.

The genesis of this mare's nest is to be found, doubtless, in the widely published statement that the main battery of these ships would be grouped forward of the bridge. Here was a change, so completely without precedent as to be absolutely sinister in its implications. What new deviltry was here afoot! To move all the turrets with their guns forward of the bridge would be to leave the after two-thirds of the deck, or a stretch of 450 feet, unencumbered.

For what other purpose could this have been done than to provide a flying deck for a fleet of airplanes, and under the camouflage of battleships provide an additional 70,000 tons of airplane displacement beyond that allowed by the Treaty of Washington! To render this precious charge of dishonesty plausible, the public was told that the boiler-room smoke was to be carried in horizontal ducts and discharged astern, and the military masts dispensed with.

That the limits of absurdity were reached in this proposal is seen in the fact that the airplanes at the end of their run, in taking off, would have had to leap-frog over a huge conning tower at least 100 feet high, and that the space below decks required for a fleet of airplanes would be pre-empted for the berthing of a crew of at least 1,200 men.

Nevertheless, this idiotic canard received widespread publicity throughout the press of the country.—*Editor*

The fact that the "Nelsons" are to mount the largest battery of 16-inch guns hitherto placed in one ship, and are to have their vitals shielded by massive armor plate, disposes of yet another fiction entertained by some naval critics: that is, that the ships in question are to be virtually bare of armor in order that they shall have the speed of battle cruisers. As a secondary battery each has twelve six-inch rapid-fire guns in twin turrets, stationed on the broadside amidships. The housing of these guns in closed turrets is a tribute to the murderous efficacy of high-explosive shell, the blast and splinters from which took a heavy toll of men behind open gun-shields in every naval action of the World War. There were occasions on which a few salvos of medium-calibre shell were enough to silence every gun not mounted in a closed turret. Additional to the guns enumerated, the ships will have a large equipment of anti-aircraft pieces.

Since the placing of all the main turrets on the foredeck pre-empts room that is usually occupied by machinery, the propelling plant has perforce had to be shifted further toward the stern. The boilers are, therefore, aft of the midship line, and the single funnel into which all the uptakes lead is situated abaft the mainmast. This gives the type a very singular appearance, further accentuated by the huge conning-towers and bridges, and still more so by the substitution of a veritable skyscraper of steel for the customary tripod foremast. Yet another grotesque touch is imparted by the "gallows" mainmast, built up with four legs, three of which are topped by director towers for the secondary armament.

The thrusting back of all this tophamper has done away with the spacious quarterdeck found in dreadnoughts of more conventional design. It looks, indeed, as though the deck space in the after part of the ship will be extremely limited, and it would be manifestly difficult to provide a landing platform for airplanes. This fact is a sufficient commentary on the rumor that each ship is to carry 60 or 80 airplanes.

Considering that the U.S.S. *Saratoga*—a ship in which practically the whole of the top deck, measuring some 880 feet by 104 feet, is left free for aviation purposes—is equipped to carry and operate only 70 aircraft, it would be interesting to learn where the *Nelson* could stow an equal number of machines, to say nothing of the provision of landing facilities for the same. Although positive information on this point cannot be quoted, it seems more than likely that the *Nelson's* contingent of aircraft will be restricted to a few light machines of the type already carried by British and American battleships for reconnaissance and gun-spotting.

"Nelson" and "Colorado" Compared

Such, then, are the two mystery ships about to be added to the British fleet, in exchange for a quartet of older dreadnoughts earmarked for the scrap-heap. Comparing the "Nelson" type with the U.S.S. *Colorado*, it will be found that there is little to choose between them with regard to artillery power. The *Nelson's* extra gun is not likely to give her an advantage in volume of fire, for the reason that the triple mounting, however ingeniously planned, does not conduce to ultra-rapid working of the guns; and I believe that the umpire in a war game would not allow nine guns in triple turrets a larger aggregate of rounds within a given period than eight similar guns twin-mounted.

So far as ahead fire is concerned, the *Nelson* has a 50 percent margin over the American ship. In broadside discharge they may be rated as equal, for the reason given; while in stern fire the *Colorado* would have everything her own way. As for speed, the *Nelson* is probably superior by a couple of knots. Failing publication of armor figures for the British ship, no comparison of protective attributes is feasible. It may, however, be taken as reasonably certain that the *Nelson* is less vulnerable at certain vital points, such as turrets, magazines and boilers, though her *average* thickness of armor may be somewhat less than that of the *Colorado*, whose protection is unusually heavy.

On the whole, the *Nelson* may be a better all-round fighting ship to the extent of her additional few thousand tons, but her tactical supremacy over the *Colorado* is by no means pronounced. Her design constitutes a somewhat radical departure from accepted canons of naval design, and it remains to be seen whether it will come up to expectation.

Which Radio Set Is Ideal for You?

The Fourth Month of Our New Service to Radio Set Purchasers

THERE are approximately 240 different types of radio receiving sets on the market, ranging from a simple crystal detector to a superheterodyne. Of this number it is estimated that there are about 171 tuned radio-frequency circuits, six transformer-coupled, radio-frequency amplifiers, twenty-one reflex sets, twenty-three regenerative receivers, several superheterodynes and numerous styles of crystal-detector sets.

This array of circuits creates a perplexing problem for the average person, when the decision is reached to buy a radio for the home. It is a purchase that requires study. In an attempt to solve the puzzle, which has been made more complex by the diversity of Greek and Latin prefixes, hundreds of prospective purchasers have written to radio editors in an effort to obtain an unbiased opinion of the ideal set. For obvious reasons the answer has always been a general one. They say that the selection depends to a great extent upon the pocketbook; how far one wishes to receive; the style of cabinet desired; the location in which the set is to be operated and many other variable factors.

The truth is that what is ideal for one is not ideal for another. Some want a set that will work in conjunction with a small, indoor loop antenna; others want a circuit equipped with dry-battery tubes, with the batteries concealed within the cabinet; some want a console model with a built-in loudspeaker; another wants a horn and his neighbor favors the disk loudspeaker; others prefer a set that works with storage-battery, six-volt tubes, and there are thousands waiting and watching the development of a circuit that will operate off the house lighting mains, dispensing with all batteries.

This list of receivers does not include every one on the market, but the fact that it comprises all of the basic and many of the leading circuits makes it truly representative of the 240 sets now being manufactured. The list is published with the hope that it will be of value to prospective broadcast listeners in assisting them to select a receiver that will render satisfactory service and in every way be ideal for their own personal needs and taste.

No attempt is made to say how far any set will cover, because a host of variable conditions govern the range of every broadcast receiver. Location of the set, skill of the operator in tuning, atmospherics, quality of material and workmanship in construction, condition of the batteries and tubes, and the type of antenna, make it impossible to place a distance guarantee on a radio set. In this listing a distant station is considered to be one at least 500 miles from the receiving antenna.

Every receiver listed here is reasonably selective in regard to reception of broadcasting stations rated not higher than 5,000 watts, provided they are at least five miles from receiving stations, using an antenna not over 100 feet long, including the lead-in. The sets are designed to be sensitive, but that feature will depend greatly upon the efficiency of the tubes, especially the detector and radio-frequency amplifiers. The volume is dependent chiefly upon the audio-amplifier unit. The distance range hinges on all these factors, together with the weather, power of the transmitter, its distance from the receiver, and whether or not an indoor or outdoor antenna is employed. The outdoor wire is more efficient for distance and it also helps to increase the volume, because, if held aloft, unshielded by buildings or other objects, it will intercept more energy from the passing ether waves than the indoor wire. An outdoor antenna is generally considered to be the equivalent of two vacuum tubes.

MANUFACTURER	TRADE NAME	TYPE OF CIRCUIT	PRICE—LESS ACCESSORIES	GENERAL CHARACTERISTICS
Adams Morgan Co., Inc.	Paragon Three	Regenerative	$48.50	Gives loudspeaker results on semi-distant stations. Single dial tuning.
Adams Morgan Co., Inc.	Paragon Four	Tuned R.F.	$65.00	Sensitive and selective. Brings in distant stations on loudspeaker with good volume.
Adams Morgan Co., Inc.	Paragon Two	Regenerative	$27.50	Gives loudspeaker results on local stations and brings in distant stations on headphones. Single dial tuning.
American Specialty Co.	Electrola	Tuned R.F.	$60.00	Low "B" battery current consumption. Cushion sockets.
Amsco Products, Inc.	Melco Supreme 24	Tuned R.F.	$140.00	Inductively tuned with three dials. Compensating condensers controlled by dials so that various types of tubes may be used. It employs four 6-volt tubes.
Amsco Products, Inc.	Melco Supreme 25	Tuned R.F.	$150.00	Same as MS-24 except five tubes instead of four.
Amsco Products, Inc.	Melco 4	Tuned R.F.	$150.00	Same as MS-24 but with panel inclined. Dry cell or 6-volt tubes. Three tuning dials.
Amsco Products, Inc.	Melco 5	Tuned R.F.	$165.00	Same as MS-25 but with panel inclined. Dry cell or 6-volt tubes. Three dials. More volume than Melco 24.
F. A. D. Andrea, Inc.	Fada-160	Neutrodyne	$60.00	Four 6-volt tubes. Three tuning dials. No "C" battery. Good for distance reception.
F. A. D. Andrea, Inc.	175-A	Neutrodyne	$125.00	Five tubes, either dry cell or storage battery type. Three tuning controls. Single switch for amplification and circuit control. Loudspeaker volume on distant stations.
F. A. D. Andrea, Inc.	175/90-A	Neutrodyne	$175.00	Five tubes, either dry cell or storage battery type. Three tuning controls. Upright console cabinet with space for batteries and charger. Loudspeaker operation on distant stations.
F. A. D. Andrea, Inc.	185-A	Neutrodyne	$175.00	Five tubes, either dry cell or storage battery type. Three tuning controls. Table cabinet with built-in loudspeaker. Drop desk door.
F. A. D. Andrea, Inc.	192-A	Neutrodyne	$85.00	Similar to cabinet of 175-A but one-third smaller. Five tubes either dry cell or storage battery type. Three tuning controls.
F. A. D. Andrea, Inc.	195-A	Neutrodyne	$40.00	Three tubes either dry cell or 6-volt type. Two dials. Box cabinet.
F. A. D. Andrea, Inc.	196-A	Neutrodyne	$100.00	Five tubes, either dry cell or 6-volt type. Three dials. No cabinet provided. Can be used with Victor models VS-400, VS-405, VS-410.
F. A. D. Andrea, Inc.	185/90-A	Neutrodyne	$225.00	Five tubes, either dry cell or 6-volt type. Three dials. Upright console cabinet with drop desk lid. Built-in loudspeaker. Space for all batteries, and charger in cabinet.
Atwater Kent Mfg. Co.	Model 10	Tuned R.F.	$80.00	Open set with apparatus mounted on a board, no panel. Three controls. Five 6-volt tubes.
Atwater Kent Mfg. Co.	Model 19	Tuned R.F.	$60.00	Two controls. Four 6-volt tubes. Open set with apparatus mounted on a board. No panel.
Atwater Kent Mfg. Co.	Model 20	Tuned R.F.	$80.00	Model 10 except that it is mounted in a cabinet.
Atwater Kent Mfg. Co.	Model 12	Tuned R.F.	$100.00	This receiver has the same characteristics as Model 10 with an extra tube added to increase volume. Three controls.
Atwater Kent Mfg. Co.	Model 24	Tuned R.F.	$100.00	Same as Model 20 except more elaborate.
Atwater Kent Mfg. Co.	No. 20 Compact	Tuned R.F.	$80.00	Same circuit as Model 20 but smaller and more compact. Five 6-volt tubes.
Autometal Corp.	Aragain	Tuned R.F.	$180.00	Five 6-volt tubes. Three tuning dials. Good for distant stations.
Cleartone Radio Co.	Model 70	Tuned R.F.	$75.00	Four 6-volt tubes. Gives loudspeaker volume on distant stations.
Cleartone Radio Co.	Model 80	Tuned R.F.	$120.00	Five 6-volt tubes. Brings in distant stations on loudspeaker. More volume than Model 70.

R. F. = Radio Frequency. Accessories = Batteries, tubes and loudspeaker. Unless specified, each set operates with regular outdoor antenna.

MANUFACTURER	TRADE NAME	TYPE OF CIRCUIT	PRICE—LESS ACCESSORIES	GENERAL CHARACTERISTICS
CLEARTONE RADIO CO.	MODEL 90	Tuned R.F.	$185.00 Complete	Seven 6-volt tubes with circuit designed to work with loop antenna.
CROSLEY RADIO CORP.	CROSLEY 50	Regenerative	$14.50	One-tube receiver built to sell at as low a price as possible consistent with good results. Will bring in stations up to 500 miles away with headphones.
CROSLEY RADIO CORP.	CROSLEY 50 P	Regenerative	$16.00	Crosley 50 in portable leatherette covered cabinet. Should be used with dry battery tubes to minimize weight.
CROSLEY RADIO CORP.	CROSLEY 51	Regenerative	$18.50	Crosley 50 with one stage of audio amplification which gives greater volume. Operates loudspeaker on local stations.
CROSLEY RADIO CORP.	CROSLEY 51 P	Regenerative	$23.50	Crosley 51 in a portable case. Two tubes. Space for batteries inside cabinet.
CROSLEY RADIO CORP.	CROSLEY 52	Regenerative	$27.50	Crosley 50 with two stages of audio amplification added to give loudspeaker operation on nearby and semi-distant stations. Two controls for tuning.
CROSLEY RADIO CORP.	52-P	Regenerative	$32.50	Same as Crosley 52 but in portable leatherette cabinet.
CROSLEY RADIO CORP.	SUPER-TRIRDYNE Regular	Regeneration plus R.F. and Reflex	$50.00	Three tubes. Two tuning controls. Designed not to radiate. Good for distant reception. Mahogany cabinet.
CROSLEY RADIO CORP.	SUPER-TRIRDYNE Special	Regeneration plus R.F. and Reflex	$60.00	Same as Super-Trirdyne regular but with more elaborate cabinet with slanting panel and battery compartments if dry cell tubes are used.
CROSLEY RADIO CORP.	51-DELUXE	Regenerative	$23.50	Double circuit with worm type tickler. Two tubes. Two controls. Sloping panel.
CROSLEY RADIO CORP.	52-DELUXE	Regenerative	$32.50	Same as 51-DeLuxe, but with an additional audio amplifier to give more volume.
CROSLEY RADIO CORP.	"PUP"	Regenerative	$9.75	Midget one-tube double circuit regenerative receiver. Two controls. Portable.
DAYTON FAN & MOTOR CO.	OEM-7	R. F.	$98.00	Four tubes. Made more selective than OEM-7 Model of 1925. Three dials. All Day-Fan receivers are prelogged at the factory and dials graduated for immediate finding of stations according to wavelengths.
DAYTON FAN & MOTOR CO.	OEM-12	R. F.	$75.00	OEM-7 stripped of all costs not absolutely essential.
DAYTON FAN & MOTOR CO.	DAYOLA	R. F.	$110.00	Same as OEM-7 but housed in drop front cabinet with inclined panel and space for "B" batteries in cabinet.
DAYTON FAN & MOTOR CO.	DAY-FAN 5	R. F.	$115.00	Five tubes. One tuning control. Inclined panel. An adjustment is provided for loud and soft pitch. Condensers designed to facilitate sharp tuning below 300 meters as well as on higher broadcast wave band.
DAYTON FAN & MOTOR CO.	DAYCRAFT	R. F.	$145.00	Same as Day-Fan 5 but with loudspeaker built in one end of cabinet. Space provided for "B" batteries.
DAYTON FAN & MOTOR CO.	DAYCRAFT 2	R. F.	$165.00	Same as Daycraft but with demountable legs.
DAYTON FAN & MOTOR CO.	DAYGRAND	R. F.	$195.00	Console model with built-in loudspeaker and space for "B" batteries. Drop front cabinet making a small desk with one pigeon-hole. Same as Day-Fan 5.
DAYTON FAN & MOTOR CO.	DAYTONIA	R. F.	$300.00	Console model with built-in loudspeaker, battery compartments and silent recharging apparatus. Same panel and circuit as Day-Fan 5.
DAYTON FAN & MOTOR CO.	DAYROYAL	R. F.	$300.00	Day-Fan 5 panel and set in vertical desk cabinet. Wired for batteries and charger but these accessories are not furnished.
DAYTON FAN & MOTOR CO.	DAYPHONE	R. F.	$105.00	Five tubes. Phonograph cabinet.
DAYTON FAN & MOTOR CO.	XL-10	R. F.	$125.00	Five tubes. Three pre-logged dials. Plate glass cabinet. This model is furnished in various cabinet styles and in a knock-down kit for $72.50.
DEFOREST RADIO CO.	D-17-M DABNEY	Reflex	$180.00	Five tube loop antenna set with vacuum tube detector. Mahogany cabinet. Built-in loudspeaker and battery compartments.
DEFOREST RADIO CO.	D-17-L DAGGETT	Reflex	$170.00	Five tube loop antenna set with vacuum tube detector. Fabricoid covered cabinet. Built-in loudspeaker and battery compartments.
DEFOREST RADIO CO.	D-17-A DALE	Reflex	$125.00	Five tube loop set with tube detector. Brown Fabricoid covered cabinet with compartments for small batteries. Loudspeaker not built in.
DEFOREST RADIO CO.	F-5-M FABER	Tuned R. F.	$150.00	Five tubes. Two color-tone mahogany cabinet with built-in loudspeaker and battery compartments.
DEFOREST RADIO CO.	F-5-L FACTOR	Tuned R. F.	$140.00	Five tubes. Two color-tone brown Fabricoid covered cabinet with built-in loudspeaker and battery compartments.
DEFOREST RADIO CO.	F-5-AW FAGAN	Tuned R. F.	$90.00	Five tubes. Walnut cabinet. No built-in loudspeaker or battery compartments.
DEFOREST RADIO CO.	F-5-AL FAIN	Tuned R. F.	$90.00	Five tubes. Brown Fabricoid covered cabinet without built-in loudspeaker but with battery compartments.
DEFOREST RADIO CO.	F-5-BW FALCON	Tuned R. F.	$85.00	Five tubes. Small walnut cabinet without built-in loudspeaker or battery compartments.
DEFOREST RADIO CO.	F-5-P FALK	Tuned R. F.	$130.00	Five tubes. Portable set in Fabricoid covered case with built-in cone loudspeaker and battery compartments. 150 feet of antenna wire on reel and 15 feet of ground wire with connector.
EISEMANN MAGNETO CORP.	TYPE 6-D	Tuned R. F.	$125.00	Three tuning controls. Brings in distant stations on loudspeaker. Five storage battery tubes.
FREED-EISEMANN CO.	NR. 7	Neutrodyne	$110.00	Six tubes of storage battery type. Second audio amplifier tube is divided between two tubes connected in parallel to avoid distortion. Three controls. Wavelength range 220-275 meters.
FREED-EISEMANN CO.	FE-18	Tuned R. F.	$90.00	Five dry cell tubes. Sloping panel of Formica. Three tuning controls. Battery compartment. Resistance in radio frequency circuit to damp out oscillations.
FREED-EISEMANN CO.	FE-15	Tuned R. F.	$75.00	Five storage battery tubes. Three tuning controls. Coupled antenna circuit to give maximum selectivity. Separate rheostat for radio amplifiers and for detector and two audio amplifiers. Resistance in radio frequency circuit to damp out oscillations.
FREED-EISEMANN CO.	NR-20	Neutrodyne	$175.00	Five-tube storage battery set built in Renaissance type chest. Front panel cover lowers to serve as writing desk. Three tuning controls.

MANUFACTURER	TRADE NAME	TYPE OF CIRCUIT	PRICE—LESS ACCESSORIES	GENERAL CHARACTERISTICS
FREED-EISEMANN CO.	FE-150	Neutrodyne	$275.00	Same as Nr. 20 except it is equipped with additional console table, one side of which contains loudspeaker and the other space is a battery compartment.
CHAS. FRESHMAN CO., INC.	5-F-5	Tuned R. F.	$60.00	Five 6-volt tubes. Wavelength range 190-550 meters. Three dials with vernier controls. Loudspeaker built in on left end of cabinet. Good for distant receiving.
GAROD CORP.	TYPE V	Neutrodyne	$195.00	Three dials used to control the tuning; a double-range, high-grade voltmeter to test the batteries. Brings in distant stations on loudspeaker. Five storage battery tubes.
GILFILLAN BROS., INC.	GN-1	Neutrodyne	$150.00	Five storage battery tubes. Three tuning controls according to standard neutrodyne circuit. Double range voltmeter. Good volume from distant stations with loudspeaker.
GILFILLAN BROS., INC.	GN-2	Neutrodyne	$120.00	Three tuning controls according to the standard neutrodyne arrangement. Double range voltmeter on panel. Five storage battery tubes.
GILFILLAN BROS., INC.	GN-3	Neutrodyne	$65.00	Four dry cell tubes. Two tuning controls. Suitable for portable use.
A. H. GREBE & CO., INC.	SYNCHROPHASE Type MU-1	Tuned R. F.	$155.00	An entirely new system of condenser mounting and dial arrangement makes tuning easy. Highly selective and sensitive. Gives loudspeaker results on distant stations. Five storage battery tubes.
A. H. GREBE & CO., INC.	SYNCHROPHASE Type MU-2	Tuned R. F.	$155.00	Arranged for use with six dry battery tubes, otherwise it is essentially the same as Type MU-1 except that an extra tube is added to make up for the lower power of dry battery tubes.
HOWARD MFG. CO., INC.	MODEL A	Neutrodyne	$200.00	Five storage battery tubes. Separate rheostat for each tube. Three tuning dials.
JEWETT RADIO & PHONO. CO.	DESK	Tuned R. F.	$140.00	Five 6-volt tubes. Two tuning dials. Wavelength range 180 to 750 meters. Good for distant reception.
JEWETT RADIO & PHONO. CO.	CONSOLE	Tuned R. F.		Same electrically as desk model except that this instrument is self-contained in console cabinet.
COLIN B. KENNEDY CORP.	MODEL 5	Regenerative	$75.00	Designed for home use to receive local and high-powered distant stations on loudspeaker. Uses either 3 dry battery or storage battery tubes.
COLIN B. KENNEDY CORP.	MODEL 3	Regenerative	$75.00	This is the Model V Kennedy receiver constructed for portability in an imitation leather case with cover containing a compartment for headphones and coiled antenna wire. Three dry cell tubes.
COLIN B. KENNEDY CORP.	MODEL 6	Regenerative	$85.00	Gives great volume on loudspeaker on local and semi-distant stations. Four tubes.
COLIN B. KENNEDY CORP.	MODEL 15	Tuned R. F.	$142.50	Two tuning controls, brings in distant stations when conditions are favorable. Five tubes.
COLIN B. KENNEDY CORP.	ROYAL 16	Tuned R. F.	$235.00	Five 6-volt tubes. Elaborate cabinet with built-in loudspeaker. Two tuning dials. Good for distant receiving.
COLIN B. KENNEDY CORP.	MODEL 20	Tuned R. F.	$90.00	Five 6-volt tubes. One tuning dial. Good for distant reception.
KLITZEN RADIO CORP.	WOLVERINE	Tuned R. F.	$54.50	Three 6-volt tubes. Two levers instead of dials are used for tuning.
MAGNAVOX CO.	No. 10	Tuned R. F.	$110.00	Five storage battery type tubes. One control. Good for distant station reception.
MAGNAVOX CO.	No. 25	Tuned R. F.	$145.00	Five 6-volt tubes. One tuning control. Cabinet with built-in loudspeaker concealed behind grille.
MAGNAVOX CO.	No. 75	Tuned R. F.	$200.00	Same as No. 10, but with console cabinet and built-in loudspeaker.
MIESSNER RADIO CORP.	BATTRYLESS	Tuned R. F.	$180.00	Six tubes. Two True Blue and four WD-11 tubes. Works off the light socket 110 volts 60 cycle current. No batteries required. Built-in loudspeaker. Three tuning dials.
OPERADIO CORP.	OPERADIO	Transformer Coupled R.F.	$189.00 Complete	A portable set of seven tubes, including dry batteries, loudspeaker and rotating loop concealed within the lining of the cover. Two tuning dials. Voltmeter for testing "B" batteries mounted on front panel. Brings in local stations with plenty of volume and distant stations.
PRIESS RADIO CORP.	PR-4	Priess Circuit	$165.00	Eight tubes, storage or dry cell type. Two controls. Loop antenna visible. Desk type cabinet.
PRIESS RADIO CORP.	PR-6	Priess Circuit	$275.00	Same as PR-4 except console cabinet self-contained.
RADIO CORP. OF AMERICA	RADIOLA III	Regenerative	$35.00 Includes two tubes and headphones.	Uses two dry-cell tubes and will operate a loudspeaker on nearby stations. Distant stations can be heard on headphones. Two tuning dials.
RADIO CORP. OF AMERICA	RADIOLA III-A	Regenerative	$65.00 Includes four tubes and headphones.	Uses four 1½-volt tubes, which can be operated by dry batteries, or 2-volt storage battery. Brings in distant stations on loudspeaker. Two tuning controls.
RADIO CORP. OF AMERICA	RADIOLA SUPER-VIII	Super-heterodyne	$425.00 Complete	Same circuit as Radiola superheterodynes listed below. Self-contained with revolving loop. Can also be used with outdoor antenna, greatly increasing range and volume. Six UV-199 tubes. Two tuning controls. Selective.
RADIO CORP. OF AMERICA	RADIOLA Super Heterodyne	Super-heterodyne	$220.00	Ordinary straight panel cabinet with stationary loop and batteries concealed within cabinet. Electrically the same as Super-VIII. Good for distant receiving. Selective.
RADIO CORP. OF AMERICA	RADIOLA 24	Super-heterodyne	$195.00 Complete	Same circuit as Radiola superheterodyne in portable suitcase, with self-contained loop. Weight, less batteries, 40 pounds.
RADIO CORP. OF AMERICA	RADIOLA 26	Super-heterodyne	$225.00 Complete	Same as Radiola 24, but with wooden cabinet and revolving loop arranged in the front cover. Extra battery box for home use.
RAINBOW RADIO CORP.	MODEL 5	Tuned R. F.	$75.00	Five storage battery tubes. Three dial control. Mahogany cabinet.
RAINBOW RADIO CORP.	MODEL 6	Tuned R. F.	$100.00	Same as Model 5 except it has six tubes.
RESAS, INC.	TONE-A-DYNE	Tuned R. F.	$78.00	Brings in distant stations with loudspeaker volume. Five storage battery tubes.
STROMBERG-CARLSON TEL. MFG. CO.	STROMBERG-CARLSON	Neutrodyne	$180.00	Fully up to the best standards for neutrodyne construction. Three tuning controls. Will bring in distant stations on loudspeaker.

MANUFACTURER	TRADE NAME	TYPE OF CIRCUIT	PRICE—LESS ACCESSORIES	GENERAL CHARACTERISTICS
SLEEPER RADIO CORP.	MONOTROL 54	Inverse Duplex	$130.00	Four 6-volt tubes. One dial. Crystal detector.
SLEEPER RADIO CORP.	SCOUT	Tuned R. F.	$75.00	Five 6-volt tubes. Two dials. Compartment for "B" batteries.
SLEEPER RADIO CORP.	SERENADER	Tuned R. F.	$100.00	Five 6-volt tubes. Two dials. Built-in loudspeaker. "B" battery compartment. Indirect lighting over dials.
SLEEPER RADIO CORP.	SUPER-SYMPHONIC	Tuned R. F.	$150.00	Five 6-volt tubes. One dial. Built-in loudspeaker. Indirect lighting over dials. "B" battery compartment. Complete shielding increases selectivity.
SPLITDORF ELECTRICAL CO.	R-400	Tuned R. F.	$60.00	Four storage battery tubes. Two tuning controls. Two radio frequency amplifiers and one audio amplifier.
SPLITDORF ELECTRICAL CO.	R-500	Tuned R. F.	$75.00	Five storage battery tubes. Three tuning controls. Two radio frequency amplifiers and two audio amplifiers.
SPLITDORF ELECTRICAL CO.	R-110	Tuned R. F.	$110.00	Five storage battery tubes. Three tuning controls. Oriental style cabinet.
SPLITDORF ELECTRICAL CO.	R-150	Tuned R. F.	$150.00	Five storage battery tubes. Three tuning controls. Enclosed loudspeaker and battery compartment.
SPLITDORF ELECTRICAL CO.	R-410-C	Tuned R. F.	$410.00	Five storage battery tubes. Three tuning dials. Console cabinet in writing desk form.
SPLITDORF ELECTRICAL CO.	R-425-C	Tuned R. F.	$425.00	Five storage battery tubes. Three tuning dials. Console cabinet in furniture style.
THERMIODYNE RADIO CORP.	TF-5	2 Tuned R. F.	$100.00	One tuning control. Good for distant stations with loudspeaker volume. Five storage battery tubes.
THERMIODYNE RADIO CORP.	CTF-6	3 Tuned R. F.	$275.00	Same circuit as TF-6, built-in console cabinet. One tuning control. Six storage battery tubes.
THERMIODYNE RADIO CORP.	TF-6	3 Tuned R. F.	$150.00	Single control for tuning. Brings in distant stations on loudspeaker. One tuning control; six storage battery tubes.
R. E. THOMPSON MFG. CO.	V-50	Neutrodyne	$125.00	Five 6-volt tubes. Three tuning dials. Good for distant receiving on loudspeaker. Straight panel.
R. E. THOMPSON MFG. CO.	S-60	Neutrodyne	$145.00	Five 6-volt tubes. Three dials. Same as V-50 except cabinet is more elaborate and panel slants.
R. E. THOMPSON MFG. CO.	S-70	Neutrodyne	$180.00	Six tubes, either dry cell or storage battery type. Mahogany cabinet with battery compartment and adapters for UX-120 tubes. More volume than V-50 or V-60. Three audio amplifiers.
R. E. THOMPSON MFG. CO.	P/11-215	Neutrodyne	$125.00	Five tubes, 6-volt type. Adaptable for standard console phonograph.
R. E. THOMPSON MFG. CO.	R-81	Balanced R. F.	$150.00	Circular mahogany cabinet, mantel design. Self-contained batteries and cone speaker. Uni-control for tuning. Five tubes, dry cell type.
R. E. THOMPSON MFG. CO.	C-61	Neutrodyne	$360.00	Five 6-volt tubes. Queen Anne console cabinet. Dual loudspeakers built in to handle high and low tones. One tuning control. Compartment for all batteries or eliminators. Designed to give high class tonal reproduction.
C. D. TUSKA CO.	TYPE 301	R. F. Reflex	$85.00	Will bring in distant stations and is highly selective. Two main tuning controls.
C. D. TUSKA CO.	TYPE 224	Regenerative	$35.00	A high-grade, single-tube receiver for those who wish to get maximum distance and selectivity with one tube. Tunes sharply with two controls.
C. D. TUSKA CO.	SUPERDYNE	Superdyne	$150.00	Two tuning controls. Brings in distant stations.
U. S. L. RADIO, INC.	RC-5	Tuned R. F.	$80.00	Five 6-volt tubes. Two tuning dials. One radio frequency amplifier and three stages of resistance coupled amplification. Good for distant stations with volume and tone quality.
WESTERN COIL & ELECTRICAL CO.	RADIODYNE WC-12B	Tuned R. F.	$100.00	Six dry cell tubes. All Radiodyne sets are tuned radio frequency circuits, adapting them for good distant results. Double-deck cabinet with space in lower compartment for batteries.
W. C. & E. Co.	RADIODYNE WC-12C	Tuned R. F.	$200.00	Six dry cell tubes. Console cabinet with built-in loudspeaker. Space for batteries in cabinet. Three controls.
W. C. & E. Co.	RADIODYNE WC-14	Tuned R. F.	$59.50	Five 6-volt tubes. Three tuning controls. Unit only without cabinet.
W. C. & E. Co.	RADIODYNE WC-14A	Tuned R. F.	$65.00	Five 6-volt tubes. Same as WC-14 but with a cabinet.
W. C. & E. Co.	RADIODYNE WC-14B	Tuned R. F.	$85.00	Five 6-volt tubes. Same as WC-14 but with two-deck mahogany cabinet with battery compartment.
W. C. & E. Co.	RADIODYNE WC-14C	Tuned R. F.	$185.00	Five 6-volt tubes. Mahogany console cabinet with built-in loudspeaker.
W. C. & E. Co.	RADIODYNE WC-15	Tuned R. F.	$59.50	Five 6-volt tubes. Two dials. Unit only without cabinet.
W. C. & E. Co.	RADIODYNE WC-17A	Tuned R. F.	$75.00	Five 6-volt tubes. Two dials. Same as WC-15 but with cabinet.
W. C. & E. Co.	RADIODYNE WC-18B	Tuned R. F.	$100.00	Five 6-volt tubes. Two dials. Same as WC-15 but with two-deck cabinet including battery compartment.
W. C. & E. Co.	RADIODYNE WC-18C	Tuned R. F.	$200.00	Five 6-volt tubes. Two dials. Console model with built-in loudspeaker.
ZENITH RADIO CORP.	ZENITH 3R	Regenerative	$175.00	Three controls. Three dry or storage battery tubes can be used. Interchangeable resistance for audio amplifier circuit are provided in case the owner desires to use dry battery or storage battery tubes with Zenith receivers.
ZENITH RADIO CORP.	ZENITH 4R	Regenerative	$100.00	Three controls for tuning. Can be used with four dry battery or storage battery tubes.
ZENITH RADIO CORP.	SUPER-PORTABLE	Tuned R. F.	$224.00 Complete	A portable set that includes the loop. Can be operated without opening cover. Six dry cell tubes.
ZENITH RADIO CORP.	SUPER-ZENITH Model VII	Tuned R. F.	$240.00	Two tuning controls. Six dry or storage battery tubes.
ZENITH RADIO CORP.	MODEL VIII	Tuned R. F.	$260.00	Same circuit as Model VII except built-in spinet desk. Six dry cell or storage battery tubes.
ZENITH RADIO CORP.	MODEL IX	Tuned R. F.	$355.00	Full cabinet style with Amplion loudspeaker enclosed. Separate compartment for storage battery. Six dry cell or storage battery tubes.
ZENITH RADIO CORP.	MODEL X	Tuned R. F.	$475.00	English wall cabinet type. Two loudspeakers for synchronizing the high and low pitches. Six dry cell or storage battery tubes.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Conducted by Albert A. Hopkins

Baking pot and its accessories

Doing the Family Baking Under One Cover

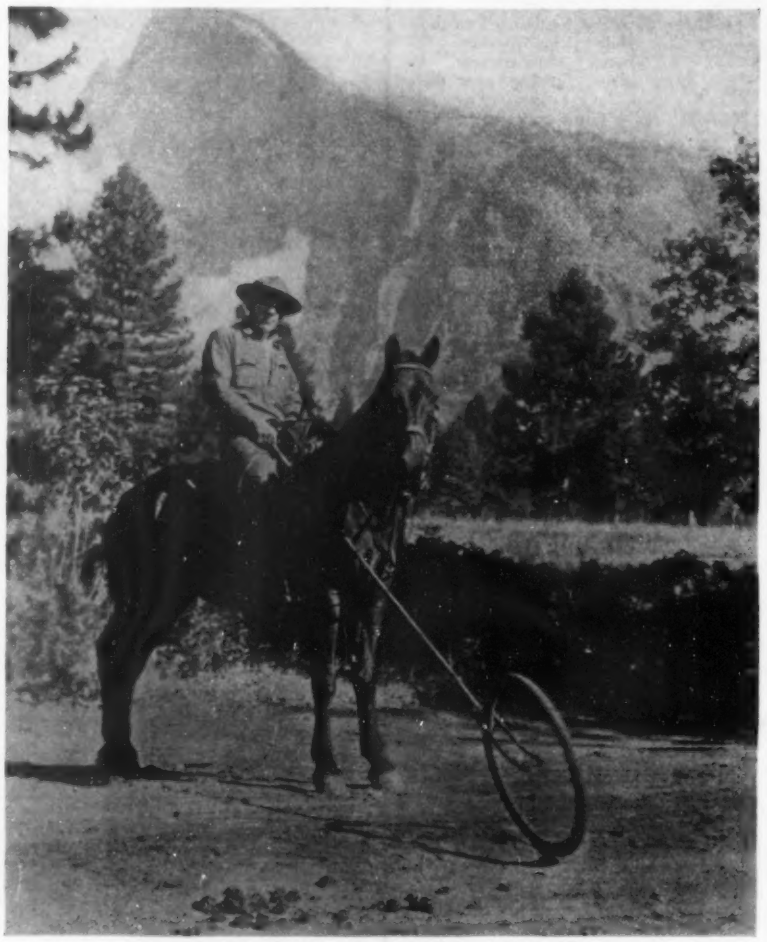
THE writer recently tested out in his home a very ingenious cooking utensil designed to be used on top of the stove. It consists of a cast-iron base which serves to hold a number of pans of different sizes and shapes. One of them is large enough to hold a chicken and smaller ones serve for cooking vegetables and potatoes could be placed on the iron base. A large aluminum cover completes the outfit. The meal was cooked with great fuel saving.

The same large pans can be used for baking bread or cake and muffin trays can be inserted alongside so that bread and muffins can be baked simultaneously. Several lifters accompany the outfit so that hot dishes may be removed without burning the fingers.

Measuring the Trail

ONE of the foresters of the Yosemite National Park has devised a cyclometer to use in connection with trips over the trail where ordinary surveying methods would be prohibitive.

He uses an ordinary cyclometer and frame attached to a long handle which he can manipulate while he is riding his horse. The cyclometer is attached to the hub. It works very nicely and gives rough computations which are all that are needed. This device is a variation of the well-known odometer.



Using the bicycle wheel in measuring trails

The Electric Smokerlite

THE device illustrated here is a convenience for the home which adds to the pleasure and comfort of the lovers of "milady nicotine." It is plugged into any convenient lamp socket or outlet. A simple pressure of the switch in a handle is sufficient to cause the heating elements to glow sufficiently to light the cigar or cigarette.

In the home or at the office the Smokerlite is an added touch of refinement. It displaces the destructive, messy match, giving a clean safe light—a constant source of satisfaction to you and a courtesy to your friends.

The dinner ready for the fire

An Auto-Lavatory for Washing the Hands

ALL those who work around automobiles know how easy it is to soil the hands and how hard it is to cleanse them when away from the house or garage. An inventor has devised a very clever attachment to the automobile which provides either water or soap and water. It consists of a tank which is placed underneath the automobile with the water faucets and the soap faucets coming from underneath the running board.

The device can be attached to splash aprons to the inside of the frame or underneath the chassis frame where both soap and water are provided. One end of the tank is devoted to the soap while the balance contains the water. The soap is in liquid form. Our illustration shows the folding water faucet in use and also the soap faucet.

Many autoists also like using a little gasoline on their hands which makes an excellent combination with the liquid soap. This gasoline can, of course, be obtained without a soap attachment.

Real comfort in the library without the aid of matches

Water and soap are now available for all automobilists

A life preserver for furniture

A Brace for Wobbly Furniture

THE device shown here consists of a brace which pulls the legs of a chair toward one another. This brace is fastened at the inner corners of all the legs, and exerts a direct pull where the seat and legs of the chair join, by means of twisting a turnbuckle which is connected to the four inner corners of the legs.

This brace is equally adaptable to other pieces of furniture such as tables, chiffoniers, beds and the like, and it insures the life of furniture at low cost by preventing splitting of the wood, racking and shakiness.

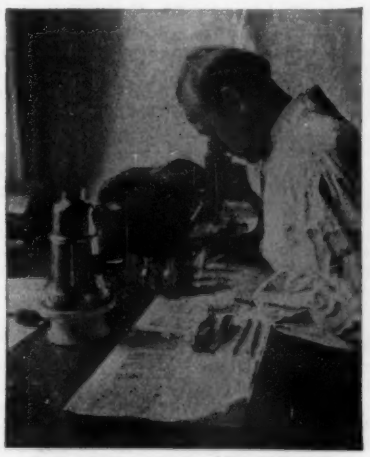
Short-cut to a Driver's License

A RATHER unusual method for teaching new car owners to drive their cars is for the instructor's car to be equipped with two steering wheels. By a chain sprocket arrangement the steering wheel used by the instructor turns the steering wheel of the pupil. In this way a beginner in motor-car driving readily becomes accustomed to steering the car. There have been other variations of this plan, but the sprocket and chain drive is very positive.

Saving the Tea-pot Cover and the Table Cloth

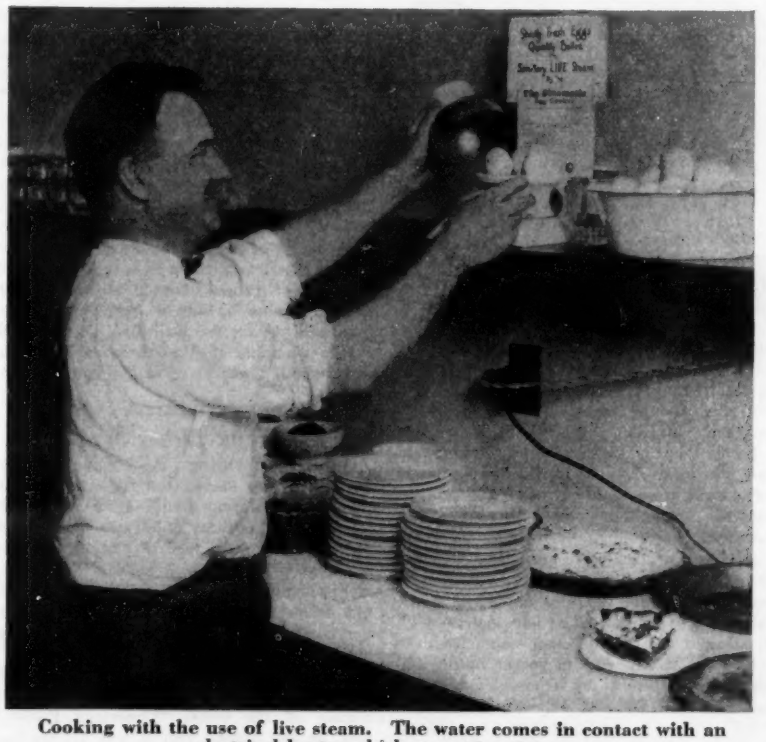
"LOOK out for the cover"! is the cry often heard when serving tea. For this little item has a peculiar habit of falling off at unexpected moments, and shattering either the tea-cup or itself.

In order to prevent these accidents, a novel cover holder has made its appearance on the market. This attachment is in the form of a spring, fastened to the handle, twisted around the knob on the cover, and under the spout. The portion of the spring which passes under the spout is equipped with a felt cushion, which serves to absorb any tea which has run down the outside of the spout.



Handy steam sterilizer

Steering wheels on an instructor's car. Much of the knack of driving a car depends upon the correct handling of the steering wheel. Here the wheels of teacher and pupil move in unison



Cooking with the use of live steam. The water comes in contact with an electrical heater which generates steam

Electrical sand pipe heater for locomotives. An electric heating coil at the end of the pipe allows the sand to flow freely

Tea-pot covers saved

Foolproof Egg Cooker and Timer

IN the device illustrated here the eggs are first put in and the cover replaced. Second, water is poured in with the small dipper provided. Electricity serves to boil the eggs. The number of dippersful of water determines the amount of cooking; the steam does the cooking. When the steam stops the eggs are done. There are two metal plates in the bottom, insulated from one another. When the water is poured in it drips down and gets between the plates where it makes electrical contact. The electricity is thus utilized and the current passes through the water. Water is the resistance.

Kelp Burning in Norway

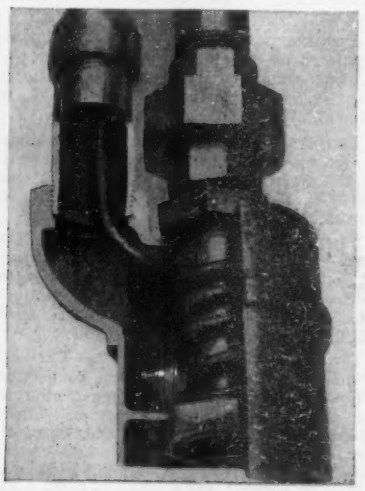
NORWAY has an interesting industry which few countries possess, namely, kelp burning. Seaweed burning is a source of income for many of the peasants along the entire Norwegian coasts, the production of ash averaging 2,000 tons per year.

Steam Sterilizer Heated by Electricity

THE sterilizer illustrated is attached to an ordinary electric light socket and steam is generated in five seconds. Only live steam reaches the instruments. The hot instruments can be poured directly on a napkin and dried promptly from their own heat.

Sand Pipe Heater for Locomotives

IN rainy weather the lower end of the pipe by means of which a locomotive delivers sand to the rails is always wet. Since sand will not flow from a wet pipe—sticking, instead, to the side of it and closing the outlet entirely—some such method as that illustrated on this page is required in order to keep the opening of the pipe dry. For this purpose an electric heating coil is now being used. It derives its current from the turbo-generator which provides power for the locomotive headlight.



Detail showing the electrical heater

Recently Patented Inventions

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRCRAFT STABILIZER.—Adapted to aircraft of all types, maintaining the craft on a substantially even "keel" during flight. Patent 1540438. J. H. Thompson, Holliday's Cove, West Va.

CONSTRUCTION OF THE BEARING SURFACES FOR AIRPLANES.—By forming all the elements comprising the wings in such manner, that in case one of them give way, the uninjured continue sustaining the stresses. Patent 1547028. G. Caproni, U. Nobile and R. Verduzio, c/o L. Laboccetta, Via Due Marcelli 31, Rome, Italy.

Pertaining to Apparel

GARTER.—Which will effectively support the hose without necessitating the use of an elastic leg encircling band. Patent 1543571. D. B. Jacobs, 157 8th Ave., New York, N. Y.

OUTING SUIT.—Consisting of a hood, coat and trousers, of waterproof construction, for enabling children to play in the rain without danger. Patent 1543582. F. W. MacKay, Silver Mine, Norwalk, Conn.

BRASSIERE.—Which produces a pleasing effect, also a binding action for rounding out the figure. Patent 1545411. S. J. Newman and W. Benjamin, c/o Newman & Sons, New Haven, Conn.

BATHING CAP.—The inventors have been granted two patents of a similar nature, the caps being so constructed as to give special protection to the ears and hair of the bather, and prevent the passage of water to the interior of the cap. Patent 1546163. (Reissue) 16111. L. and M. Auster, 229 Fourth Ave., New York, N. Y.

BLOOMER CONSTRUCTION.—Which will effect a neat fit at the waist and will not restrain the movement of the limbs or body. Patent 1547136. J. Hochberg, 31 W. 27th St., New York, N. Y.

Electrical Devices

ELECTRIC VIBRATOR FOR RAZORS AND THE LIKE.—Providing a device for supporting and vibrating a razor blade for use in shaving the beard. Patent 1542846. G. Adelmo, West St. Paul St., Spring Valley, Ill.

SWITCHING DEVICE FOR RADIO SETS.—In which it is merely necessary to open the switch to disconnect all the wires at one time and instantly. Patent 1544486. J. Sedlak, 2660 8th Ave., New York, N. Y.

PLATING DEVICE.—In which the electroplating bath is in constant motion, greatly increasing the speed in which a given deposit may be made. Patent 1544027. J. J. Mueller, Jr., c/o Superior Metal Co., Bethlehem Pa.

ELECTROTHERAPEUTIC GLOVE.—Easily manipulated on the hand, for combining with massage treatment an electrotherapeutic action on the skin. Patent 1545413. G. W. Elmvall, 25 South St., New York, N. Y.

SWITCH.—Including a metal fabric having spaced conductors bridged by a coin inserted in the apparatus to close a circuit. Patent 1544978. R. J. Hall, 136 Stewart St., S. W., Grand Rapids, Mich.

TIME-CONTROLLED ELECTRIC-SWITCH SYSTEM.—For use in connection with any form of actuating mechanism, a great variety of control being secured with comparatively simple units. Patent 1545728. C. H. Beck, 44 Third St., San Francisco, Calif.

COMBINATION SLIDE DEVICE.—For diagrammatically producing group connections for polyphase armature windings of alternating current motors or generators. Patent 1545921. T. Paul, 1 Connaught Apt., 4th Ave. West, Calgary, Canada.

MAGNETIC MOTOR.—In which a uniform driving torque on the shaft is produced solely by magnets respectively on the stator and rotor. Patent 1546720. R. H. Davis, c/o W. K. Hudson, Box 47, Hartshorne, Okla.

News for Inventors

A Department of Facts and Notes of Interest to Patentees and to Owners of Patent and Trademark Rights

Conducted by Milton Wright

Foreign Patents

THE following letter and its answer may prove of interest to readers of this department:

Cleveland, Ohio,
August 8, 1925.

The Scientific American,
New York, N. Y.
Dear Sirs:

I read with interest the "News for Inventors" department. I wish you would tell me if you know of any great profit made by American inventors as a result of their taking out patents in the following foreign countries: Canada, England and France.

Thanking you in advance, I am
Yours very truly,
(Signed) William Morris.

There are numerous examples of Americans who have greatly increased their profits through obtaining patents in England, France and Canada. The first names among our immediate acquaintances which come to mind are, Mangels whose amusement devices have thrilled visitors to Coney Island, Riehl with a number of ingenious amusement patents and Schroeder with fleshing devices.

Ford, Edison, Westinghouse, McCormick and other inventors who have made large fortunes all have taken out patents in foreign countries, and it is well known that big manufacturing companies such as the General Electric Company and the Western Electric Company not only take out foreign patents, but build factories abroad the output of which consists of articles patented in the United States and other countries.

Whether it will pay to patent in foreign countries, depends, of course, upon the market there. Generally speaking, if a patented article is profitable in the United States it will pay to patent it in other countries, taking into consideration the cost of transportation, duties and other necessary expenses.

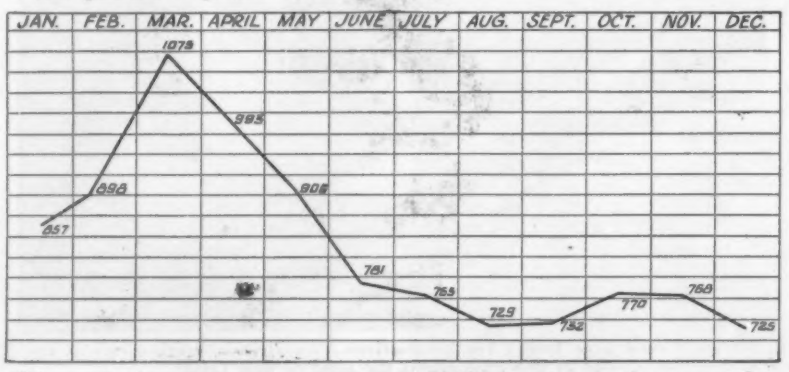
A Quick Sale

"HOW does a man sell an invention?" is a question often asked by inventors. Here is the experience of Jacob Franz, a manufacturing jeweler in John Street, New York City.

Franz specializes in platinum mountings. He split a ring in two, placed annular recesses in each section and set precious stones in the recesses. The two ring sections were then riveted together with elements which acted as both rivets and spacers.

Thus he invented a new type of ring. He went to a patent attorney to have a patent applied for, but before the application was sent to Washington, he sought an importer of precious stones.

"I wanted to get stones to sell the rings," said Franz. "The importer, when he saw what I had, wanted to get the ring to sell his stones. Each of us needed the other and he suggested a sort of partnership arrangement. This would have meant complications, for I have a going business already, so I suggested he buy all my rights to the invention. He consented at once, paid $3,000 cash and I turned it over to him. That isn't a fortune by any means, but it more than paid me for the little time I spent, and I have a number of other inventions pending upon which I expect to realize considerably more."



This graph shows how many out of every 10,000 inventors in the course of a year seek patents in any particular month. The rate has been the same over a period of fifteen years

Wrong Either Way

CARR, MEARS & DAWSON, Incorporated, are denied the right to register the word "Filipino Drill" as a trademark for naval and military uniforms. The ground of the decision is that the words are descriptive of the goods, if used in their ordinary meaning, and that, if the clothing is not made of drill and the material does not come from the Philippine Islands, the mark is deceptive.

This decision recalls the famous brief of the Chicago lawyer who was refused registration of the words "Limestone Brand," first, on the ground that it was descriptive, and then, on the ground that it was deceptive. Among a long list of examples, his broadside declared:

"Ivory is a good trademark for soap not made of ivory. Gold Dust washing powder is not made of gold. Old Crow whiskey is not distilled from crows. There is no bull in Bull Durham. Royal baking powder is not used exclusively by royalty, nor is Cream baking powder made of cream. Pearline contains no pearls and White Rock is water."

Of Interest to Farmers

CUTTER ATTACHMENT FOR PLOWS.—Adapted to be attached to any standard type of mold-board plow for cutting sod or grass forward of the plow. Patent 1534098. W. G. Wood, Fellsmere, Fla.

INSECTICIDE CONTAINER AND DISTRIBUTER.—Which has simple, reliable and efficient pneumatic means for causing the discharge of finely divided powder, and means for controlling the air pressure. The inventor has been granted two patents of a similar nature. Patents 1540197 and 1540198. A. P. Treadwell, Box 977, Atlanta, Ga.

GUARD AND LEDGER PLATE.—Which may be quickly attached to or detached from agricultural machinery, such as reapers or mowers. Patent 1540157. J. P. Bagan, 543 Pender St., W. Vancouver, B. C., Canada.

WEED PULLER.—Which can be readily associated with a wheeled draft vehicle and advanced above the crops to pull the weeds without damaging the crops. Patent 1538,829. P. N. Larson, Suffolk, Mont.

MUZZLE.—For cattle or live stock, preventing an animal from eating too ravenously of vegetation. Patent 1543784. J. B. Miner, c/o Henkle & Miner Land Co., 1010 Wall St., Bend, Oregon.

ATTACHMENT TO THE GRAIN-CLEANING DEVICE OF A GRAIN-HARVESTING MACHINE.—Which will prevent overflow caused by the accumulation of weeds and insure a clean sample of grain. Patent 1544494. A. G. H. and A. C. E. Spoehr, c/o Collison & Co., 463 Collins St., Melbourne, Australia.

BEET HARVESTER.—Having means for taking hold of the top only and thereby pulling the beet from the ground. Patent 1544887. J. W. Burtless, c/o Somerville & Kiplinger, Farmers & Merchants Bank, McCook, Neb.

HOG OILER.—Which includes a freely swingable gateway adapted to cause a discharge of oil onto the animal as it passes through. Patent 1546898. H. H. Hinken, Winner, S. D.

REVERSIBLE PLOW.—Wherein the plow proper will be maintained in the ground to the proper depth but may be readily reversed. Patent 1546844. G. O. Lee, Box 152, Lynchburg, Va.

Of General Interest

OVERFLOW ALARMS.—A device for overflowing icebox pans; will ring a bell repeatedly for several hours to give ample warning. Patent 1532604. P. Schmitz, 654 Merrick Road, Lynbrook, L. I., N. Y.

KITCHEN FURNITURE.—Affording a chopping block for meats or vegetables, a surface for rolling dough, or may be used as a storage cabinet. Patent 1541692. R. B. Elison, 208 Lafayette St., Bordentown, N. J.

COMBINED HOLDER AND ASH TRAY.—In which a cigar or cigarette may be securely retained so that the ashes will not fall upon adjacent objects. Patent 1541732. J. Nagy, 336 E. 53d St., New York, N. Y.

LAWN SPRINKLER. — Which will more closely simulate the action of rain by projecting the spray from an elevation. Patent 1541702. G. Geisendorfer, Box 52, Warrenton, Ore.

WATCH SUPPORT.—Which is collapsible and formed for supporting a watch in upright position so that the dial may be observed. Patent 1542672. G. B. Crapo, 49 Union Place, Lynbrook, N. Y.

PAPER FOLD.—Constituting an independent device for containing pictorial illustrations or printed matter. Patent 1541734. S. Nowak, 8827 190th St., Hollis, L. I., N. Y.

PENHOLDER AND PROTECTOR. — Whereby the point cannot be engaged by the hand or the clothing when placed in the pocket. Patent 1541916. P. M. Biondo, 72 Throop Ave., Brooklyn, N. Y.

MOLD FOR MAKING CONCRETE BLOCKS.—Adjustable for making blocks of different

sizes, and for making several blocks in a single mold. Patent 1542021. C. W. Akers, 174 Third Ave., No., Nashville, Tenn.

MARINE PAINT.—Which will prevent barnacles and vegetable growths from forming, and also will preserve the wood. Patent 1542790. G. W. Relyea, 10 Lawrence St., Charleston, S. C.

EDGE SPACER FOR CULTIVATED GRASS PLOTS.—By the use of which the margins of lawns or grass plots can be more neatly trimmed. Patent 1541160. B. MacDonald, South Pasadena, Cal.

DEVICE FOR USE IN VIEWING MOTION PICTURES.—That will prevent injury to the eyes by minimizing the strain, adapted to be worn with or without glasses. Patent 1540604. A. I. Clymer, Van Wert, Ohio.

BUILDING TILE.—Of plastic or cementitious material, so constructed as to provide means for facilitating their handling. Patent 1540686. G. Ey, 307 E. 87th St., New York, N. Y.

HEEL-TREAD PAD FOR HORSESHOES.—Capable of adjustment to fit the heels of shoes of various widths. Patent 1540701. J. W. Miller, 112 E. 7th St., Red Wing, Minn.

ANTISLIP SHOE SOLE.—Which will yield a cushion like, durable sole, having an antislip structure for preventing slipping in any direction, on wet surfaces. Patent 1541234. H. A. McKnight and F. E. Burns, 242 Turk St., San Francisco, Cal.

QUOIN.—The inventor has been granted two patents of a similar nature, wherein a positive engagement is provided between two adjacent quoins for holding them in any adjusted position and locking them against accidental shifting. Patents 1541770 and 1541771. J. J. Curtis, 146 W. 10th St., New York, N. Y.

FISHHOOK HOLDER.—Which may be employed for retaining "fly hooks" or plain hooks, with or without leaders attached, in an orderly fashion. Patent 1543120. M. Raber and J. H. Cummings, 116 Lava Road, Bend, Oregon.

HOSE COUPLER.—Whereby the sections may be quickly connected or separated without the necessity of loosening bolts or fastenings, by means of tools. Patent 1543356. M. H. Arnold, c/o T. E. Mitchell, 325 Citizens National Bank, Los Angeles, Cal.

VALVE.—For use with steam steering gear, so constructed as to control the steam without elaborate structure. Patent 1542851. G. T. Bollinger, Lockport, La.

EDUCATIONAL APPLIANCE.—For teaching the principle of time with relation to the revolution of the earth on its axis. Patent 1543067. C. H. Dunlop, 145 Halsey St., Brooklyn, N. Y.

HEEL PLATE.—Which may be firmly secured in a rubber heel to provide antislipping and wearing qualities. Patent 1543024. W. A. Morris, 121 So. Roberts St., El Reno, Okla.

WRIST-WATCH BAND.—In the form of an ornamental metal band adapted for attaching any kind of watch on the arm. Patent 1543399. H. K. Smith, 56 Pier Ave., Hermosa Beach, Calif.

Hardware and Tools

COMBINATION SAW.—Which is portable, and may be used as a cross cut, rip or double or single miter saw. Patent 1543051. J. H. Bloodgood, R. No. 4, Box 44, Tampa, Fla.

FASTENER FOR WINDOW SCREENS OR STORM WINDOWS.—For holding a screen or storm window so that it will not rattle or let in cold air or dust. Patent 1542888. T. O. Iverson, 219 10th St., S. E., Rochester, Minn.

NUT LOCK.—In which the threads of the various parts will be protected against moisture and dirt. Patent 1543633. H. J. Van Gelder and J. Ward, 463 Bedford Ave., Brooklyn, N. Y.

SAFETY RAZOR.—Including a flexible double edged blade, with means for adjustment for a coarse or fine shave. Patent 1543587. J. F. O'Malley, Box 184, Flushing, L. I., N. Y.

Heating and Lighting

ROTARY KILN.—The lining of which is so constructed that a maximum heating surface is presented to the raw material passing therethrough. Patent 1544504. C. J. Tomlinson, West Allis, Wis.

ASH SCREEN.—Which can be readily inserted into the ash pit of a furnace, and serve to separate the cinders from the ashes. Patent 1546194. H. Bornkessel, 8519 109th St., Richmond Hill, N. Y.

SAND DRIER.—Having a positive circulation of hot air in close association with downwardly flowing sand passing through a hopper. Patent 1547114. C. S. French, Box 3, Eckman, W. Va.

Machines and Mechanical Devices

WINDMILL.—Which automatically feathers the blades, and presents them to the wind for maximum power. Patent 1540609. A. Debay, c/o C. Baldus Dept. Store, Springdale, Penn.

GAS-SEPARATOR APPARATUS.—For separating fluids of a high specific gravity from fluids of a low specific gravity when said fluids are mechanically mixed. Patent 1539,968. C. F. W. Tabler, Apdo 1164, Tampico, Mexico.

PADDED COVERING FOR IRONING ROLLS.—So constructed that it will not pack or char and will outlast the usual covering for ironing machines. Patent 1539916. K. H. Siever, 151 Center St., Keyser, W. Va.

VALVE FOR CYLINDERS.—Constructed in such manner that pressure fluid under any ordinary pressure cannot escape past the relatively moving parts. Patent 1540181. H. Olson, c/o M. F. Smith, 7 First Natl. Bank Bldg., Hoquiam, Wash.

COIN-CONTROLLED OPERATING MECHANISM.—Which is particularly adapted for use in soda water fountain or like machines dispensing liquid. Patent 1540175. A. S. Mandel, c/o J. Rothberg, 208 Eldridge St., New York, N. Y.

STOCK REGISTER.—Whereby quantities of a plurality of different articles may be counted in any predetermined sequence. Patent 1539919. J. P. Swift, c/o Swift & Atkins, Waynesville, N. C.

ADVERTISING APPARATUS.—Which periodically transfers an illuminated display from one compartment to another. Patent 1540,661. R. W. St. Clair and J. R. Irvin, Indiana, Pa.

MOSS-CLEANING APPARATUS.—In which not only the sticks and dirt are removed, but blowers act upon the moss to dust it. Patent 1540200. W. D. Tyler, England, Ark.

REFRIGERATING APPARATUS.—Comprising a compressor embodied in a casting with coils for carrying the gases, and operating mechanism. Patent 1541482. H. P. Culver, 122 Olentangy St., Columbus, Ohio.

SHUTTLE.—Provided with means, in the form of a box, within the recess of the shuttle, for mounting the tensioning pins. Patent 1541666. J. Shaw, 348 Union Ave., Paterson, N. J.

PROCESS FOR SEPARATING GAS FROM LIQUIDS.—Which comprises simultaneously cooling and centrifugally separating the fluids of different specific gravities. Patent 1540963. C. F. W. Tabler, Apdo 1164, Tampico, Mexico.

TRAVERSE GUIDE AND THREAD CLEANER.—Adapted to be mounted on the traverse bar of a spooling and winding machine. Patent 1541721. D. Lewis, 601 So. Irving Ave., Scranton, Pa.

GRINDING MACHINE.—For sharpening lawn mower blades, producing an even edge throughout the length of the blade. Patent 1542624. J. D. McClelland, 40 W. 6th St., Mt. Vernon, N. Y.

PIPE-BENDING APPARATUS.—For easily bending pipes at various angles without flattening or pinching the pipe, the device is readily portable. Patent 1542355. G. E. Barker, c/o E. A. Barker, Osage, Iowa.

GUDGEON FOR BULL WHEELS.—For use in connection with well drilling machinery, the construction is strong but light, and transportable in a knocked-down state. Patent 1542253. M. H. Ketzebue, Box 1963, Tulsa, Okla.

ICE CHUTE.—Which will readily discharge a block of ice from a storage plant without the salesman having to enter the building. Patent 1542651. J. Alessandro, c/o Guper Ice Co., Waco, Texas.

SEPARATOR.—Which will rapidly separate solid matter of different kinds, from liquids, requiring little power or attention in its operation. Patent 1542288. W. L. D'Olier, c/o Munn, Anderson & Munn, Woolworth Bldg., New York, N. Y.

WATER WHEEL.—Which may be advantageously employed in streams where the level of the water varies at different times. Patent 1543004. E. J. Goodding, Camanche, Calif.

Medical Devices

PORTABLE SURGICAL LIGHT.—With a concentrating beam adapted for projecting into localized areas without interfering with the operator's vision. Patent 1542011. H. R. Simpson, 1005 Mission St., San Francisco, Calif.

TONSILLOTOME.—By means of which the severing and removal of the tonsils may be effected without injury to the surrounding tissues. Patent 1545761. J. J. Gurtov, 2001 Grand Concourse, Bronx, N. Y.

ATOMIZING APPARATUS.—Wherein medicated liquids are mixed and brought to a desired temperature for use. Patent 1546,238. F. T. Horiuchi, c/o Manhattan Eye, Ear and Throat Hospital, 210 E. 64th St., New York, N. Y.

Musical Devices

TUNING DEVICE.—With means for comparing the vibration of a tuning fork, and a piano string, to determine whether the string is in tune. Patent 1516947. L. J. Beindorf, 1046 N. California Ave., Chicago, Ill.

Prime Movers and Their Accessories

SPARK PLUG.—Having simple means to combat excess oil in the combustion chamber and create an extremely hot spark. Patent 1543628. R. L. Stover, 812 W. 25th St., Oklahoma City, Okla.

IGNITION DISTRIBUTOR.—So constructed that the life of the distributor is prolonged, the efficiency increased, and the noise dispensed with. Patent 1543377. H. Ford and G. H. Taylor, c/o Harry Ford, J. D. Root & Co., Staffordshire, England.

INTERNAL-COMBUSTION ENGINE.—In which a rotary valve is provided for each cylinder presenting a maximum opening for both the intake and exhaust. Patent 1545336. W. Lawrence, 38 Prescott Rd., Prospect Park, White Plains, N. Y.

PISTON—Which may be adjusted to any desired diameter either at the original setting up or after it has been worn. Patent 1545,450. H. W. Pierce, 52 E. Broadway, Butte, Mont.

VALVE FOR INTERNAL-COMBUSTION ENGINES.—In which the intake and exhaust valves are housed in one valve casing. Patent 1545822. O. J. F. Fajen, Stover, Mo.

Railways and Their Accessories

RAILWAY HAND CAR.—Which is of light weight, collapsible, and may be carried as part of the regular train equipment. Patent 1543624. B. S. Snowden, 177 No. Allen St., Albany, N. Y.

PUMP-CONTROL VALVE FOR LOCOMOTIVE TRAIN LINES.—In the form of a double-piston valve which gives the engineer of a leading locomotive, control of the second locomotive, in a "double header." Patent 1543552. W. Coulson, 293 So. 2nd St., Mechanicville, N. Y.

Pertaining to Recreation

GAME APPARATUS.—Comprising a rebounding element having indicia thereon, which when the object comes to rest will be displayed. Patent 1543616. F. Pfeifer, Sr., 285 Wallace St., Freeport, L. I., N. Y.

GAME.—Of the spinner type, having means for actuating and stopping the pointer, in the center of, instead of between the characters. Patent 1542874. K. Hampel, 1710 Crilly Court, Chicago, Ill.

GAME APPARATUS.—Involving a spinning top bearing symbols representing different values, and tokens to be paid out according to the value determined. Patent 1544500. E. L. Sweet, 218 Pine St., Wallace, Idaho.

GAME APPARATUS.—Which requires skill, steady nerves and patience, and is calculated to stimulate all three. Patent 1545569. M. M. Newton, No. Woodland Rd., Gate Mills, Ohio.

EXERCISING APPARATUS.—So constructed that it may be employed in the capacity of dumb-bells, or a weight pulling machine. Patent 1546187. F. Bach, 65 Cooper Sq., New York, N. Y.

GAME.—Wherein the judgment of throwing is used in connection with the ability to catch a projected article. Patent 1547070. J. Rich, 2664 Grand Concourse, Bronx, N. Y.

Pertaining to Vehicles

SIGNAL DEVICE FOR MOTOR VEHICLES.—Which is intended to indicate the general direction of the vehicle and its relative speed. Patent 1542431. F. M. White, 7247 Grand Ave., Chicago, Ill.

SEAT.—Having cushioning means so constructed as to practically prevent rebound in traversing rough surfaces. Patent 1542,675. L. B. Demuth, R. F. D. No. 3, New Philadelphia, Ohio.

STEERING DEVICE.—So arranged that an efficient driving connection is maintained when the wheels are turned to their extreme position. Patent 1542436. C. L. Craig, Washington, Ohio.

PROCESS FOR MANUFACTURING ELASTIC TIRES WITH RECESSES FILLED WITH AIR UNDER PRESSURE.—Comprising an india-rubber ring, with tightly closed recesses at right angles to the middle, the whole being enclosed within a casing. Patent 1542791. C. E. Veil-Picard, 76 Avenue de Wagram, Seine Deptmt., Paris, France.

TRANSMISSION GEARING.—In which the shifting of gears such as employed in the ordinary type of transmission is eliminated. Patent 1542701. T. M. Joyner, 403 Clark St., White Bear Lake, Minn.

SHOCK ABSORBER.—More particularly in the form of a rugged and durable mounting assembly for shock absorbers as used on vehicles. Patent 1541943. R. M. Gruss, 3320 20th St., San Francisco, Calif.

CLUTCH-PEDAL CONTROL.—For controlling the pedal of a Ford in high, low or neutral position, without the operator maintaining his foot on the pedal. Patent 1542904. R. L. Nordness, c/o Annex Hotel, Bismarck, N. D.

COMBINED SAFETY VALVE AND SIGNAL FOR PNEUMATIC TIRES.—With means to permit the inflation of an inner tube, and an audible signal if the pressure fluid is escaping. Patent 1543077. J. H. Gall and G. Swanson, 1211 Denney May, Apt. B, Seattle, Wash.

STILE.—Which provides a means for the passage of motor vehicles through fences used for the purpose of confining cattle. Patent 1543091. J. T. Berthelote, 706 3rd Ave. No., Great Falls, Mont.

AWNING FOR AUTOMOBILES.—Adapted to be supported by the automobile top and extend laterally for shielding the sun rays or rain. Patent 1543593. R. E. Bentley, 220 So. Crochet St., Sherman, Texas.

AUTOMOBILE BODY.—Of the closed type, so constructed that the seating capacity can be increased, or the seats adjusted to form beds. Patent 1542854. C. J. Carlson, Lexington Apts., Helena, Montana.

RADIATOR CAP.—Having simple means for maintaining a flow of air through the upper portion of the radiator to maintain the water cool. Patent 1544017. G. K. McCord and H. H. Schwark, c/o Libby, McNeill & Libby, Fort Worth, Texas.

STEERING-GEAR CONNECTION.—Which may be applied in position without altering standard parts, and which effectively eliminates twisting of the steering post. Patent 1545,363. A. C. Teves, 8448 121st St., Richmond Hill, N. Y.

Designs

DESIGN FOR A TOY GOOSE.—Patent 67,417. A. W. Scott, Jr., 63 Navy St., Venice, Cal.

DESIGN FOR A PEDESTAL FOR MERCHANDISE DISPLAY FIXTURES.—Patent 67673. E. T. Palmenberg, c/o J. R. Palmenberg & Sons, 63 W. 36th St., New York, N. Y.

DESIGN FOR A COMBINED SOAP HOLDER AND GRAB RAIL.—The inventor has been granted two patents of a similar nature. Patents 67735 and 67736. J. H. Balmer, 29 Plane St., Newark, N. J.

DESIGN FOR A CASING FOR A DIRECTION INDICATOR.—Patent 67747. A. DE VELASCO, 2317 W. 6th St., Los Angeles, Calif.

DESIGN FOR A CONSOLE CABINET OR SIMILAR ARTICLE. Patent 67732. J. Zitzerman, 449 Stone St., Brooklyn, N. Y.

DESIGN FOR A TOWEL-BAR POST. Patent 67681. J. H. Balmer, 257-269 Plane St., Newark, N. J.

DESIGN FOR A STOVE.—The inventor has been granted two patents of a similar nature. Patents 67774 and 67775. W. F. Allen, c/o Allen Mfg. Co., Nashville, Tenn.

DESIGN FOR TIRE TREAD.—Patent 67,830. C. Escher, 104 Baldwin Ave., Jersey City, N. J.

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

The mammoth new electric locomotives for the Virginian Railway were especially designed to draw long, heavy trains over the Alleghany Mountains

Giant Locomotives—Steam and Electric

THIS is the age of mammoth constructions in the broad field of engineering. The rate of increase is such that one has ceased to say of any constructive work: "This is the limit. We can go no further." Nevertheless, it does seem as though in the "Virginian," the enormous locomotive which dignifies the head of this page, the limit of size, weight and power for a single unit had been reached; for although the "Virginian" was built several years ago and many a powerful locomotive has been built in the intervening years, this giant still towers head and shoulders above the others and has the distinction of being the heaviest and most powerful locomotive in the world.

The conditions which led the Virginian Railway, after which the locomotive is named, to order from the American Locomotive Company several locomotives of this unprecedented size forms a story in itself which we will briefly tell.

The Virginian Railway was built for the sole purpose of moving coal from the rich New River and Pocahontas fields to tidewater at Norfolk. From the very beginning this road has been noted for heavy rolling stock, long trains and high operating efficiency. Nearly all of this coal tonnage originates west of Elmore and the long and heavy trains have to be hauled between Elmore and Clark's Gap, a distance of about fourteen miles, over a grade of 2.07 percent, which grade extends for eleven and one-half miles.

Beginning in 1907, the company introduced the powerful Mallet locomotives, and the size and power of these has progressively advanced to keep pace with the growing volume of the traffic. The first installment consisted of four engines with a tractive power of 70,800 pounds. Then followed eight more of 90,000 pounds tractive power. Next, came a single engine with a tractive power of 100,800 pounds, followed by a fourth lot of six engines in which the tractive power rose to 115,000 pounds.

The engine is compound, and each pair of cylinders drives its own set of five-coupled wheels. The steam, at 215 pounds boiler-pressure, is admitted first to the pair of high-pressure cylinders which are mounted on the main engine frame at about the mid-length of the boiler. The cylinders of these simple engines are 30 inches in diameter by 32 inches stroke. A pair of compound cylinders, which have the enormous diameter of 48 inches with a stroke of 32 inches, are mounted, together with the leading pair of wheels and the ten five-coupled drivers as a separate unit, the whole forming a massive swivelling truck, capable of independent movement when the locomotive is rounding a curve. The forward half of the boiler rests by means of suitable bearing upon this truck. The tender carries twelve tons of coal and 13,000 gallons of water. The consumption of coal is about six and one-half tons per hour and it is conveyed to the furnace continuously by a mechanical stoker.

It should be noted that although the "Virginian" is rated as a compound locomotive, it may be used also as a simple locomotive whenever it is desirable. When working compound, the steam, after being expanded in the pair of high-pressure cylinders, is further expanded in the pair of forward cylinders.

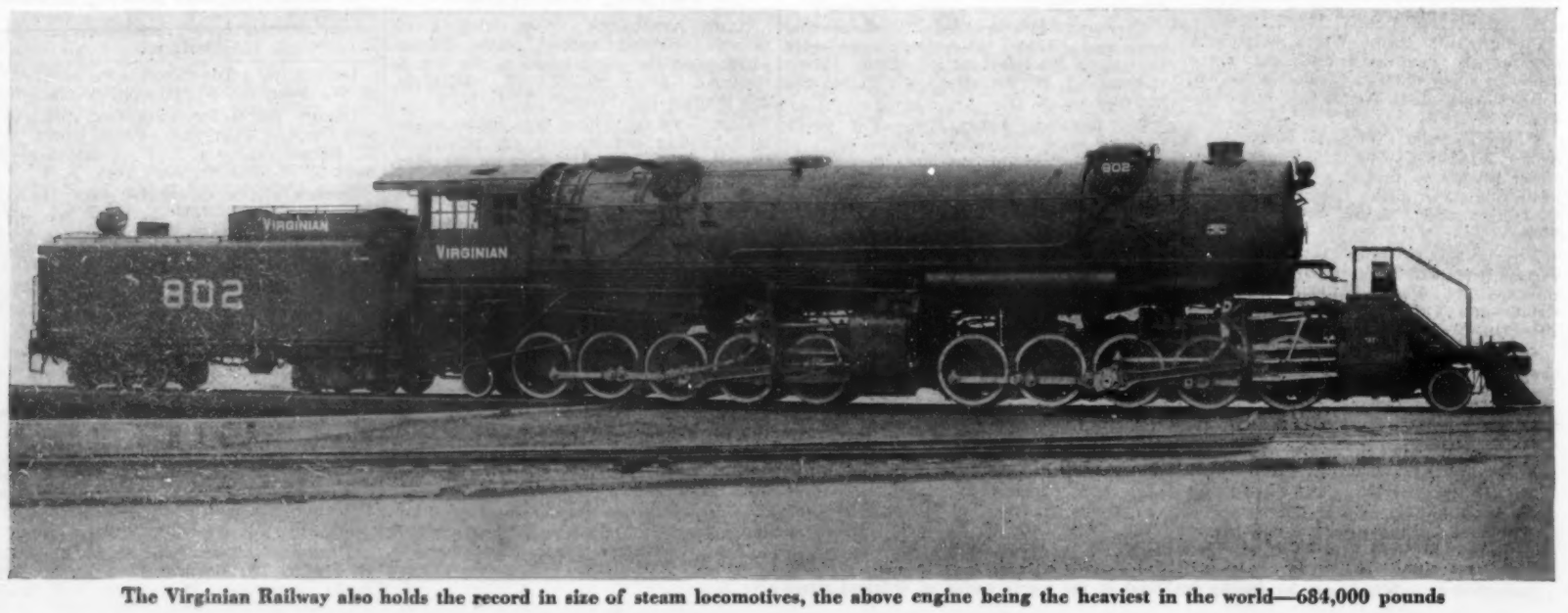
Although the present system of steam operation is efficient, it is costly. The expense of maintaining the large Mallet engines is high, and many well-known losses and expenses incident to steam operation are magnified in such an intense and heavy service as this. Moreover, the coal fields served by the Virginian Railway have scarcely been scratched; and it is realized that the coal tonnage will steadily increase. The management has realized that extensive improvements and additions would be necessary to meet these traffic increases; and the careful analysis of conditions made by the engineers of the Virginian Railway, assisted by those of the Westinghouse Electric and Manufacturing Company, showed that substantial economies would be realized by electrifying that part of the road which lies between Mullens and Roanoke.

After a study of various systems it was decided that the requirements of the service would best be met by a high-voltage, alternating-current system. Because the purchase of outside power might at times place a limit upon the supply, it was decided by the company to build their own power house at Narrows, Virginia. Power from this station will be fed each way on 88,000-volt transmission lines.

To meet a demand for the application of greater power to the trains as the traffic increases, the transformer stations' trolley line and locomotives have been designed for either 11,000 or 22,000 volts between the trolley and the rail.

The first of the locomotives that will be used on this electrification is shown in the illustration at the top of this page.

(Continued on page 262)



The Virginian Railway also holds the record in size of steam locomotives, the above engine being the heaviest in the world—684,000 pounds

RCA *announces* three new power tubes *for greater volume*

RCA, concentrating great efforts on the study of vacuum tubes, has developed three important new Radiotrons. They will be widely used in sets of all kinds in the last stage of audio frequency amplification. Their contribution to radio progress is *greater power.* They mean greater volume on dry batteries—and greater volume on storage batteries. They mean better tone, because they mean volume of sound *without distortion.*

These new Radiotrons are now ready for general sale, after months of testing.

UX-120 UX-112 UX-210

For details and technical description of the new Radiotrons, write to the nearest RCA office for the illustrated booklet.

Radiotron UX-120—*A new powerful amplifier tube that means greater volume of tone on dry batteries.* **$2.50**

Radiotron UX-112—*A new power tube similar to the familiar UV-201-A but several times as powerful.* **$6.50**

Radiotron UX-210—*A super-power tube, several times as powerful as UX-120. Probably the most powerful receiving tube in existence.* **$9.00**

RCA **Radiotron**

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AN RCA PRODUCT

RADIO CORPORATION OF AMERICA . NEW YORK . CHICAGO . SAN FRANCISCO

does everything/
-costs only ½ to ¼ as much!

The Corona Portable Adding machine, though covering no more desk space than an ordinary letterhead has *all* the desirable features of any adding machine made regardless of size or price! Never before has such efficiency been combined with portability, *real portability!*

And the Corona Portable Adding Machine costs only *one-half* to *one-fourth* as much!

Modern business has long sought a small conveniently proportioned adding machine—one handy, light, compact—one as easily reached for when wanted as the telephone. And of course one speedy, accurate and dependable, and *economical.*

Here it is—in the Corona Portable Adding Machine. Not built merely as a small, light machine for small businesses, but built for use anywhere and everywhere adding machines are needed. In hundreds of offices from the largest, such as the Chicago Milwaukee & St. Paul Railroad, The Pullman Company, The Equitable Life Assurance Co., the C. B. & Q. Railroad and similar concerns, to the smallest, the Corona Portable Adding Machine is daily proving its ability to do *all* the work, speedily and accurately.

If you now own a big machine mounted on a stand or too heavy to be moved from desk to desk, fine. Use it for overflow work but give each figure worker a Corona Portable Adding Machine for his own desk. No waiting, no delay, no standing in line for a turn at the adding machine if your office is Corona equipped.

If you do not own an adding machine the Corona is the one you will likely buy once you give it a trial.

The Corona Portable Adding Machine is principally sold and serviced by Corona Typewriter Dealers all over the world. For free demonstration call the Corona dealer in your city or write for name of nearest one.

Add!
Subtract!
Multiply!
Divide!

The Corona Portable Adding Machine adds & lists up to 99,999.99, has **Totals** and **Subtotals, Non Print, Clear, Repeat** and **Error Keys, Full Flexible Keyboard. Big Bold Type,** and, best of all—it is

Portable!

The Corona Portable Adding Machine is small and compact weighs only 16 pounds yet its simplified, condensed construction makes possible *heavier* and *stronger* working parts, on the average, then those used in any other machine.

Guaranteed Accurate, Speedy and Dependable

Send for Booklet!

The remarkable story of the invention and perfection of the Corona Portable Adding Machine, together with time saving tables of Decimal Equivalents and Reciprocals sent free without obligation. Send coupon today.

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343 South Dearborn Street, Chicago, Ill.
Send me, without obligation, free booklet and the tables of Decimal Equivalents and Reciprocals.

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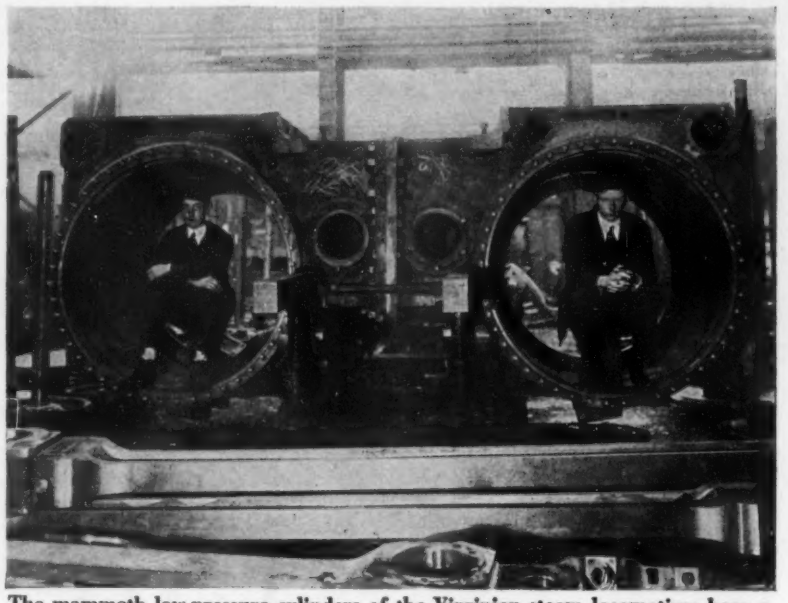
State.....



The mammoth low-pressure cylinders of the Virginian steam locomotives have a forty-eight inch bore

The three semi-permanently coupled motive-power units are operated as a single unit for the sake of interchangeability; but only the controller in the front end of the leading cab is used at one time. Acceleration to the running speeds is obtained by varying the resistance in the secondary or rotor circuit of the traction motors, a liquid rheostat being provided for this purpose. The control position includes an auxiliary controller, in which are placed switches for operating the pantagraph, buttons for independent operation of the different rheostats, and a button for tripping the circuit breakers.

The locomotives are automatically regenerative; that is, when descending a grade of such amount that the net tractive effort becomes negative, the motors become generators and return power to the line.

Each motive power unit has the Mikado or 2-8-2 wheel arrangement, the weight per cab being approximately 425,000 pounds; so that the weight of the three-cab road engine is 637.5 tons.

The maximum tractive effort of each motive-power unit, as limited by electrical capacity, is 92,500 pounds, which occurs at an adhesion slightly under 30 percent. At the conservative starting adhesion of 25 percent, the tractive effort is approximately 77,000 pounds per unit, or 231,000 for the three-unit road locomotive. This is 57 percent greater than the compound rating of the single 2-10-10-2 steam-pusher engine and 31 percent greater than the simple rating. The continuous tractive effort of the three-cab locomotive is 135,000 pounds at 14.2 miles per hour and 78,800 at 28.4 miles per hour.

In the high-speed connection of the motors, the locomotive can exert 6,000 horsepower continuously, which is far in excess of that possible by any steam locomotive in existence. The horsepower of an electric locomotive increases with increasing tractive effort while the reverse is true in the case of steam locomotives. It should be remembered that it is horsepower, not tractive effort alone, that moves trains over the track expeditiously. A steam locomotive could be built to produce a large tractive effort but it would have to be at low speed and horsepower because of the limited boiler capacity.

The cost of electric power for the trains will be less than the cost of coal for steam locomotives. This is due to the more efficient burning of the coal in the power house and to the absence of large standing losses, which are of necessity a part of steam locomotive operation. This reduction in power cost, however, is offset by the maintenance and depreciation of the transmission and distribution system.

* * *

White Ants and the Damage They Do

EACH spring or fall, numerous small flying ants (our native termites or white ants) emerge from the woodwork of buildings that have not been properly constructed. They have entered the woodwork because, somewhere, there is untreated wood in contact with the ground.

Recently, the Bureau of Entomology has been advocating slight modifications of the

(Continued on page 264)

Book ruined by termites at Van Buren, Arkansas. This book was taken from a shelf in an infested building

Like so many little prisons

—no break-outs

Just one punch, and a score of sound, clean-cut little prisons are formed from a Micarta blank—prisons from which there is no escape, no "break-outs," no cracks, no split partitions.

It's Micarta 222!

The illustration shows a clean job, from a single die that incorporates all of the possible difficulties encountered in the punching of a material of this kind. Note the absence of ragged edges. You see no tendency to break, nor to round-off at the corners. An extraordinary example!

Possibly you'd like to "get the feel" of Micarta 222, an actual punching as is illustrated here. It's an interesting little disc, three inches in diameter, which you'll enjoy examining.

May we send you one, free, and without obligating you? Please use the coupon.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY · *Offices in All Principal Cities* · *Representatives Everywhere* · Localized Service—Men, Parts, Shops

There's No Escaping the Superior Quality of MICARTA

Born of a pressing need for an insulating material of structural strength, Micarta, in 1910, was first introduced to commercial America. The leader then, Micarta still enjoys its reputation as the great pioneering material useful in a thousand and one different ways. The following list will give you an idea of its present applications. There's a still longer list we've never heard about. Maybe you can add to it.

Airplane Firewall
Airplane Propellers
Bushings
Brush Holders
Bus-bar Insulation
Bases
Book Covers
Cord Terminals
Conduits
Cleats
Couplings
Cable Joint Insulation
Channels
Cores
Discs
Entrance Bushings
Embossed Washers
Fan Blades
Fair-leads
Gears
Gaskets
Handles
Ignition Coil Boxes
Impellers
Jumper Bushings
Knobs
Liners
Markers
Mandrels
Panels
Pinions
Pulleys
Punchings
Radio Parts
Rail Joint Insulation
Switchboards
Switch Bases
Strain Insulators
Shims
Spacers
Spools
Transformer Spacers
Telephone Apparatus
Valve Washers
Washers
X-ray Transformer Insulation

Free—a sample Micarta Disc for the asking!

This sample punching will be sent to you on request, free.

JUST USE THE COUPON

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East Pittsburgh, Pa.

Please provide me with a copy of your new folder F-4944 containing one of the Micarta Discs illustrated here.

Name.....
Address.....
Company.....

Westinghouse

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LIKELY as not you'd say "it's wood" when asked what a piano-action is made of. Now you know that it is HARD MAPLE. Same with the neat, flat platter you cut your bread on. It's HARD MAPLE. Play checkers? They're HARD MAPLE. So are tubs. So are tooth-picks, & steering-wheels on good autos. And good auto bodies. Also railway ties. HARD MAPLE, everybody's everyday good wood, sure enough. Can you guess the 148 other vital & artistic applications of HARD MAPLE, that World-standard "105%" hardwood? "Let's find out."

The New Hard Maple Book tells you. It's very interesting. And authentic. And worth filing. Free on request.

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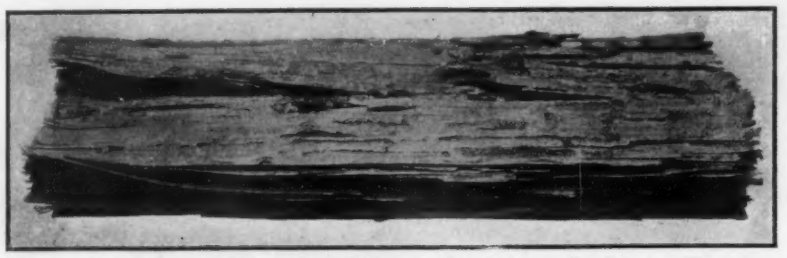
311 F. R. A. Building, Oshkosh, Wisconsin

NOTE: Hard Maple can be had in *mixed shipments* with Beech, Birch and other desirable Northern Hardwoods. Write for list of member mills.



Damage done to pine timbers in building at New Orleans, Louisiana. Note how the wood has been reduced to ribbons

building regulations of various cities in an effort to prevent attack by these insects. No untreated wood should be laid on or in the earth; untreated beams should have at least an inch of concrete between them and the earth. Where it is desired to put wood in direct contact with the earth, it should first be impregnated with coal tar creosote. If this is not practical there should be foundations of concrete or stone. No lime mortar should be used in brick work in foundations of buildings, since termites are able to penetrate lime mortar after a few years' service. Such brick work, either on or extending below the surface of the ground, should be faced and capped with concrete at least one inch thick.

Termites are not like ants, which can be killed by insecticides or fumigation. They must be prevented from getting into the building from the ground by means of their hidden burrows through untreated woodwork.

The Department of Agriculture has received many requests this year for help in getting rid of flying ants. It is a great hardship for a householder on a moderate salary to have to spend several hundred dollars one or two years after purchasing a building because of damage by termites. The fault is with the architect or contractor and the householder should not have to pay. By insisting on complete insulation of all untreated woodwork from the ground, insurance against attack by termites can be secured.

Farmer's Bulletin No. 1037, which may be obtained from the U. S. Department of Agriculture, describes in detail the work of termites and gives instructions concerning how to cope with these pests.

* * *

Do You Want a Pet Buffalo?

IT is now possible to purchase live elk and buffalo, as well as buffalo hides and heads for mounting, from the Government. The future of the buffalo is at last assured and the herds are now becoming productive, says Dr. E. W. Nelson, Chief of the Biological Survey of the United States Department of Agriculture.

A few years ago these big game animals were so much hunted that they were fast approaching extinction, but now, under the care of the Biological Survey at the Wind Cave National Park, a game refuge in South Dakota, and the National Bison Range in western Montana, the animals are increasing in numbers to an extent which justifies a practical utilization of the herds. This is particularly the case when the number of buffalo increases beyond the available area and food supply of the game reservations on which they are maintained.

The Biological Survey calls attention to the fact that in perpetuating this noble species of American big game it now becomes possible to use an annual surplus, including heads and hides as by-products. Proper wild-life administration includes calling the matter of the surplus to the attention of sportsmen and others who might be interested, to the end that persons wishing buffalo trophies or meat or even live animals may know where they may be had.

Many of the surplus buffalo can be used alive by transporting them to other suitable areas for restocking purposes or for exhibition in public parks. A limited number not suited to or required for these purposes will be slaughtered each year and their meat used. The by-products are available for those desiring buffalo trophies and are offered for sale by the Biological Survey at $35 to $60 each for heads; and $40 to $80 each for robes suitable for rugs or coats.

Live buffalo, suitable for exhibition and breeding purposes, are offered at $115 each, crated and loaded on the cars at Hot Springs, South Dakota, and Moiese, Montana. Further information will be supplied to those requesting it, by the Warden, National Bison Range, Moiese, Montana, or the Warden, Wind Cave National Park Game Preserve, Hot Springs, South Dakota. There are also a number of surplus elk on these two reservations which the bureau has arranged to sell at $65 per head, crated and loaded on the cars. Six bull elk were recently sent to the Pennsylvania State Game Commission for liberation on a suitable range in Elk County. A herd of elk was placed on this range several years ago and the animals have done so well that it was deemed advisable to secure six young bulls as an addition to the herd.

Several shipments of big-horn sheep have come into the United States recently as a result of the courtesy of the Canadian Government. These animals—eight ewes and four bucks—were captured in one of the Canadian parks, shipped into Montana, and turned loose in 1922 on the Montana National Bison Range. On this 18,000-acre game refuge in the northwestern part of the state they have bred twice, and the flock now numbers twenty-eight.

As far as is now known, the breeding of mountain sheep is similar to that of domestic sheep, with which 75 and 80 percent lamb crops are not unusual. The Biological Survey, therefore, confidently looks forward to the time when the mountain sheep on the Montana Bison Range will number 500. With such a flock, allowing a wide margin for losses, there should in time be 350 or more available each year for shipment from the range to stock suitable areas throughout the United States.

One shipment of mountain sheep recently received in this country from the Canadian Government was placed on the Custer State Park and Game Refuge in the Black Hills of South Dakota. There is an enormous acreage of good mountain sheep country in the western United States, and there is no finer big game animal for such areas than the big-horn.

* * *

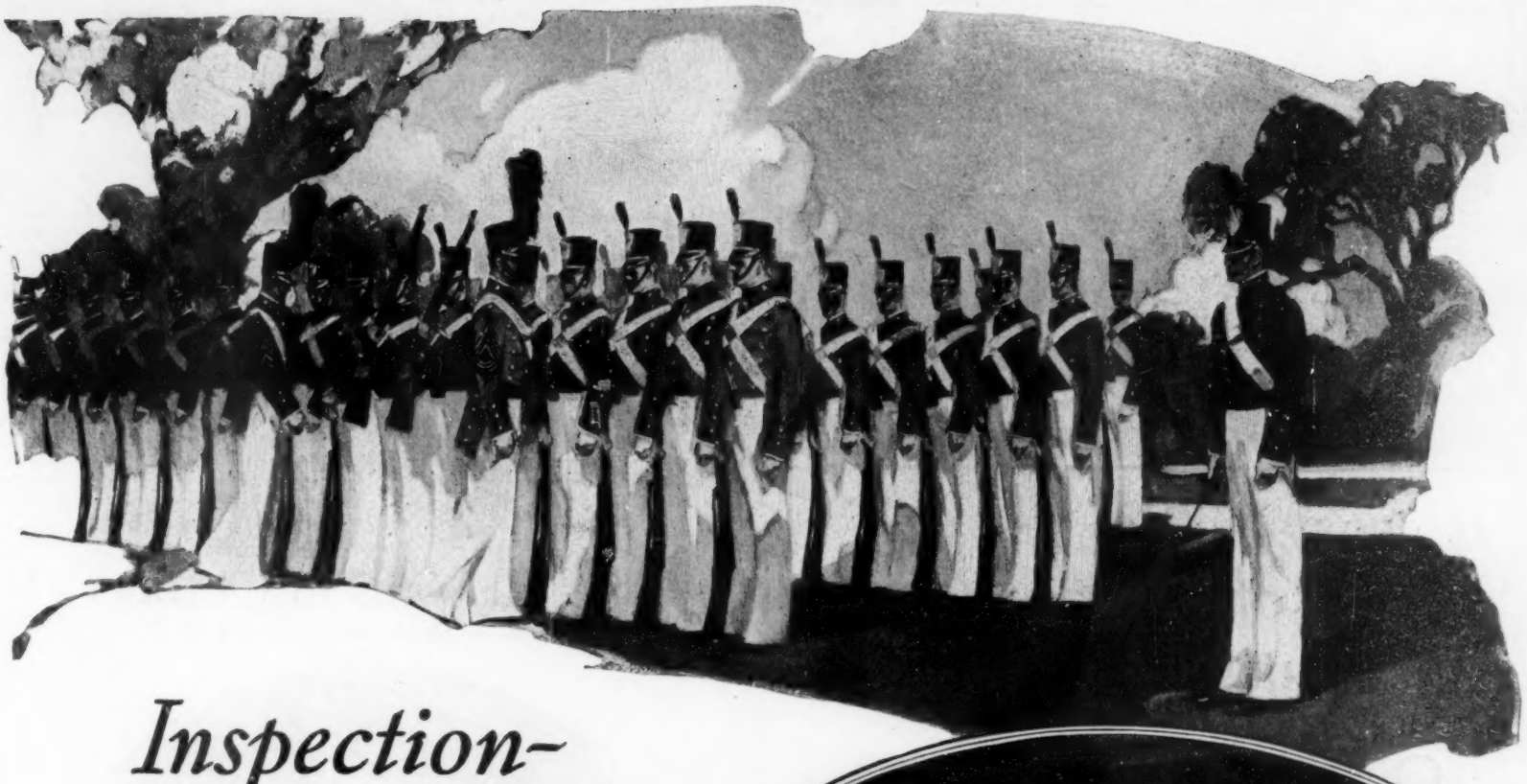
New Books on Evolution

THREE good books that have just been published are Professor Lull's "The Ways of Life," Professor George C. Scott's "The Science of Biology" and Henshaw Ward's "Evolution for John Doe."

One can quite easily attain a speaking acquaintance with evolution without a knowledge of biology. If, however, there is time and the will, a systematic textbook study of elementary biology will provide the background for a much better comprehension of the significance of the factors in evolution than could otherwise be had.

"The Science of Biology" by Professor Scott is a college textbook. It is designed for adult minds; but let this not frighten the would-be reader, for no previous scientific knowledge is required of him. This book begins at the bottom (protoplasm) and explains everything as it goes along through higher and higher forms of life until the present top—man—is reached. The evidences of evolution are amply treated.

(Continued on page 266)



Inspection— Inspection— Inspection!

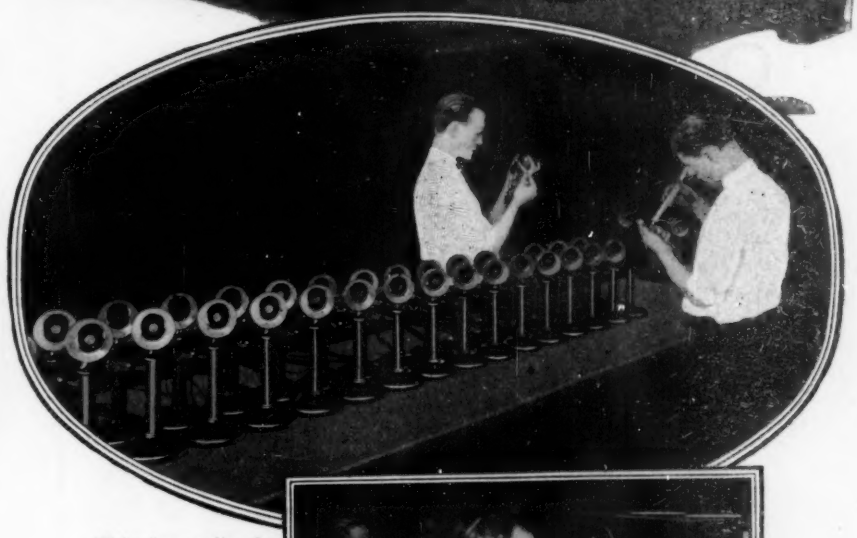
—makes good soldiers and good telephones

At West Point and Western Electric, the order of the day is the same—inspection, inspection, inspection.

A vast army of small parts must pass muster before they can assemble in telephone formation. And any part found unfit for duty is rejected.

One part must measure up to standards within a thousandth of an inch. Another must be ready to obey the command of a tiny electrical current.

Constant watchfulness is kept over all the apparatus which Western Electric makes. It starts with the careful selection of raw material. It goes through every step of the manufacture. It gives you, finally, a telephone that, like a good soldier, can serve on any front.



Telephones lined up for inspection.

Roll Call. Checking up on tone quality.

Western Electric

SINCE 1869 MAKERS OF ELECTRICAL EQUIPMENT

"It was 1902, I tell ye!" "You're off! I put that Arguto up myself in 1901."

ONE of the old boys is wrong, but what's the difference? If the only argument you ever get out of a bearing is whether it lasted 23 years or 24 years there's no cause for complaint.

The fact that Argutos never fail to deliver a generation of uninterrupted service *without a drop of oil or a minute's attention* is the main issue—and one that will pay you to look into. They eliminate danger of fire from overheated bearings, the spattering of oil over expensive materials, the danger of oiling while in motion and the expense of shutdowns for bearing replacement. Their price is about one-tenth that of bronze yet have a bearing surface that requires no oil or grease in a life time.

Write us if you make or operate loose pulleys and light shafting.

ARGUTO OILLESS BEARING COMPANY

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Arguto OILLESS BEARINGS

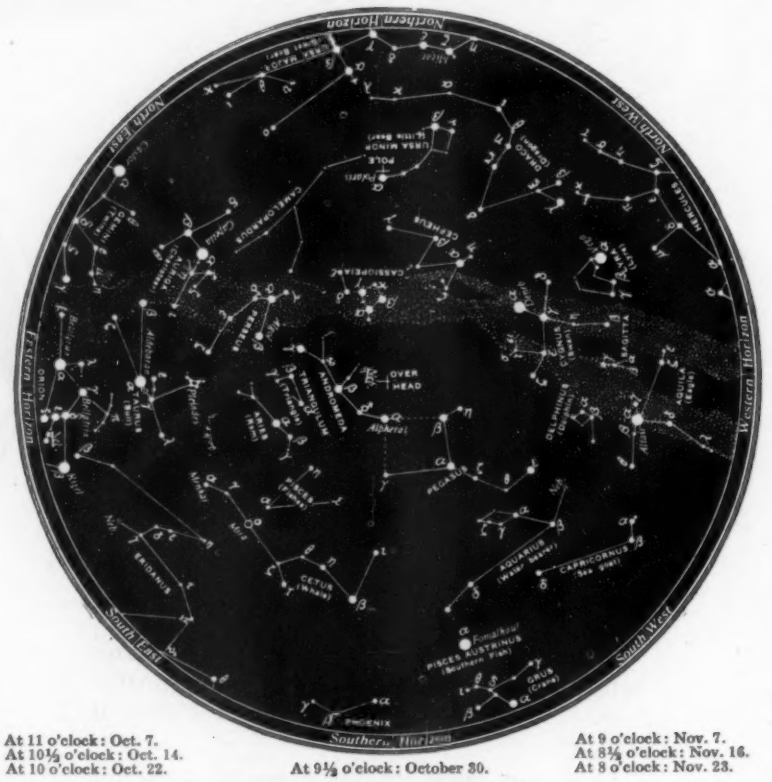
Dr. Lull, the author of "The Ways of Life" is professor of paleontology at Yale University, and therefore, is ably fitted to take up evolution in its historical sense, that is, the story of the development of invertebrates, fishes, reptiles and mammals as it occurred down through the millions of past years of the earth's long career. His new book is, in our opinion, the best popular book concerning evolution now available for the serious reader. It tells everything one would be likely to want to know about evolution in order to consider himself ordinarily well informed. An ample treatment of the evolution of man is included; and the final chapter is devoted to a discussion, among other things, of the long, historical background of evolution. The idea that animals evolve from other animals started with the Greeks and never long lacked a great defender. What Darwin did in evolution was what Marconi did in wireless, he took an old idea that had never been sufficiently developed and, by a lifetime of work, as Professor Lull aptly states it, he "put it on the map."

The book for John Doe—I do not like the title—is essentially a *psychological* approach to evolution. It recognizes that many people are prejudiced against evolution and that the main source of their prejudice is the idea that man is the descendent of an anthropoid ape. Therefore "Evolution for John Doe" ignores man's descent from the apes.

The author's method of approach to evolution consists in providing at the start an exceptionally large background about plants and animals and what has been observed about them—all tending, of course, to bring out the fact of evolution in the mind of the prejudiced reader without irritating him. It would be just the book to present to a friend who entertained preconceived and erroneous ideas about what evolution means, and who was rather "touchy" about the whole subject. It would not irritate him. For our own readers, however, we recommend works which tell the whole truth—man's ape-like descent and all. If our readers were afraid to hear the entire story, we doubt whether they would be reading this magazine, having in mind the first word of its name.

The Heavens in October

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Oct. 7.
At 10½ o'clock: Oct. 14.
At 10 o'clock: Oct. 22.
At 9½ o'clock: October 30.
At 9 o'clock: Nov. 7.
At 8½ o'clock: Nov. 16.
At 8 o'clock: Nov. 23.

The hours given are in Standard Time.

NIGHT SKY: OCTOBER AND NOVEMBER

The Heavens

IN our map of the heavens we may depart for a moment from our usual description, and pick out a few old and young stars. The youngest conspicuous one is Betelgeuse, now just above the eastern horizon—a typical early giant, Beta Pegasi, at the upper right-hand corner of the square, is young too. Aldebaran represents a later stage, and Capella one still more advanced. Then comes Deneb, in Cygnus, and, at the top of the temperature scale, the stars of Orion's belt. Vega is definitely older and Altair follows, along the main sequence. Stars in more advanced stages are less conspicuous. Beta Cassiopeiae follows Altair then Zeta Hercules (now setting). Later come the decided dwarfs, Epsilon Eridani and Tau Ceti—both well in sight. Cygni 61 marks about the last stage which is visible to the naked eye, while the white dwarfs are all far too faint to be seen without a telescope.

The Planets

Mercury is in conjunction with the sun, and on the far side on the 7th, and is substantially invisible. Venus is an evening star in Scorpio, and is so far south that she sets at 7 P.M. Mars is a morning star, rising after 5 A.M. at the end of the month, and visible in the dawn.

Jupiter is in quadrature on the 7th, and observable in the evening. Saturn is an evening star, setting at 8 P.M. in the middle of the month. Uranus is in Pisces, just past opposition, and observable telescopically, while Neptune is in Teo rising an hour or two after midnight.

The moon is full just after midnight on the 2nd; in her last quarter at 2 P.M. on the 9th; new at 1 P.M. on the 17th; in her first quarter at 2 P.M. on the 24th, and full again at noon on the 31st. She is nearest us on the 25th, and farthest off on the 11th.

During the month she passes near Neptune on the 12th, Mars on the 16th, Mercury on the 17th, Saturn on the 19th, Venus on the 20th, Jupiter on the 23rd, and Uranus on the 28th, none of the observable conjunctions being close.

"The best product we ever built"

No builder but thrills with pride at the words "the best product we ever built"—no designer, worthy of the name, but finds in them the great reward.

Thousands of designers and builders have found their path to "the best product we ever built," made easy by Sheet Steel. Today it is serving American industry in countless ways in an ever-broadening circle of applications.

The methods of manufacture, the machines used in production, the possibilities of finish—all of these details are changing with such kaleidoscopic rapidity, that eternal study is required if the designer is to realize the most from this magic material.

Take the art of spot welding. Twenty years ago, when done at all, the welds were painstakingly made one at a time—the greatest of skill was required and even then results were not dependable. Now a girl can operate the motor-driven machines that are all but automatic and that weld two, six and even eight spots at each contact.

This is just one of the improvements that have made possible replacement of thousands of castings with stronger, lighter parts stamped of steel.

Examples can be found everywhere in automobiles, in office files, in farm machinery or in kitchen equipment—wherever a better product is wanted at a lower cost.

Why not investigate the possibilities of Sheet Steel now? We will be glad to help you in working out your problems. Our booklet, "THE SERVICE OF SHEET STEEL TO THE PUBLIC" contains many stimulating thoughts—a copy comes free on request.

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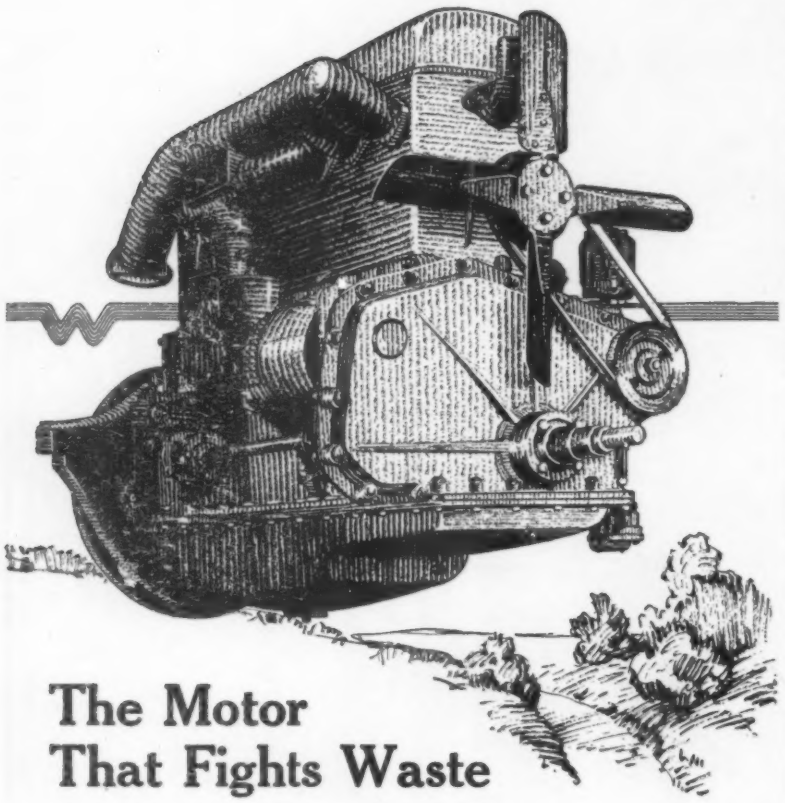


The Motor That Fights Waste

YOU men who follow keenly the costs of motor transportation know how often profit or loss lies in *that last mile-per-gallon.*

The builders of Wisconsin motors realize that *an extra mile or two per gallon* often spells operating profit instead of loss. Particularly when dealing with heavy-duty bus or truck motors, on account of the large quantities of fuel and oil used.

These highly developed motors do deliver that extra mileage—consistently—over all other types of engines.

At the convenience of interested executives, Wisconsin will demonstrate these facts conclusively.

Write for the brief, interesting data.

Wisconsin "Z", 6-cylinder, 4½" x 5"; peak horsepower, 105 at 2000 R.P.M.

Wisconsin "Y", 6-cylinder, 3⅜" x 5"; peak horsepower, 75 at 3000 R.P.M.

Wisconsin "S-U", 4-cylinder, 4" x 5"; peak horsepower, 50 at 2000 R.P.M.

Wisconsin Motor Mfg. Co., Milwaukee, Wis.

Temperature of Ocean Depths

That our readers "follow through" is shown by this letter:

"When you were writing of the device for measuring the temperatures at the bottom of the ocean, page 406 of the June issue, why did you not give us some idea of those temperatures?"

Right! And the answer is quite interesting. Below 6,000 feet the temperature is quite uniformly 37 to 40 degrees, Fahrenheit, the lowest recorded temperature being 34 degrees at 13,560 feet. At a depth of 1,200 feet the temperatures run from 53 degrees to 64 degrees.

A Rare Occurrence

Dr. Houghton had an unusually interesting experience in Switzerland. His description of the phenomenon furnishes a stimulus for the imagination. Perhaps you have had an experience similar to that of Dr. Houghton; if so, we would like to hear about it.

"The letter of Mr. Bertram E. Hall in the February number of the Scientific American detailing his experience with a 'frozen cloud' on Mount Custer, South Dakota, attracted my attention, due to the fact that I had encountered a similar experience in Switzerland in the winter of 1910-1911.

"The party of which I was a member left Lucerne about 6 o'clock in the morning for Grünewald, intending to participate in the winter sports. Two hours later, we took steamer on the Lake of Thun. There was a fine rain falling, almost a mist. The clouds were high but still covered the tops of the mountains on both sides of the lake. In the course of two hours, the temperature dropped and the rain or mist ceased, and again for some two hours the weather remained stationary, except for a continually falling mercury.

"Eventually the clouds rose and finally drifted away. The sun broke out and then we saw what must defy description. Above what must have been the previous cloud line, the trees and shrubbery, even the rocks, reflected the winter sunshine with a peculiar brilliancy that I have never seen elsewhere. It seemed as if the side of the mountain glowed with its own light, which of itself was peculiar and could scarcely be characterized. The line of demarcation was as accurately depicted as if drawn with a ruler.

"The effect lasted for some time and later I had opportunity to examine the cause. There was no generalized coating of ice such as is often seen in northern climates after a freezing rain. The ice in this instance seemed to exist only in isolated patches, and to take on the form of large crystals quite thickly covering each twig but always discrete.

"Natives told me that the phenomenon was seen usually every third or fourth winter, and that it was due not to a frozen rain but could occur only when under proper temperature conditions of air and earth, the water of the clouds and atmosphere froze as it was precipitated."

Harris A. Houghton, M.D.

Every Boost Helps

Mr. Remy was our first reader to tell us that he liked our new department, "Science and Money." Thank you, Mr. Remy. It's a big encouragement to know that our efforts to please our readers are appreciated.

Dear Editor:

I have read the article on investments in your April issue and have enjoyed it very much. Your policy is excellent of indicating general trends, leaving to the bankers recommendations of specific securities.

I look forward with interest to further articles, dealing with the trend in other industries.

William B. Remey.

A Novel Garage

From Mr. W. Sinclair Duncan of Springfield, Massachusetts, comes a photograph of a three-level garage, "utilizing the corner of two streets with a steep incline, enabling one to run off the street at either elevation." Believing that you might like to second the motion for more such garages, we are glad to present the subject in this department.

How a difficult corner was turned to good account

Meteorites

It is sometimes said that "seeing is believing," so we present the accompanying photograph, which shows what a meteorite did in Savannah, Georgia.

Dear Editor:

On the night of August 27, 1924, a blazing meteorite fell in the city of Savannah, Georgia, and embedded itself in the solid concrete pavement for about half an inch. The heat developed by the friction through the air and by the impact was such that the meteorite fused itself into the solid concrete so that it required a hammer and a cold chisel to remove it. The meteorite was about 1½ by 1 by ½ inches, and was dark gray, nearly black, in color. It was stony and not metallic in character, and was quite brittle, so that it broke into several pieces in removing it. Its specific gravity was about that of granite.

It was plainly heard by many people, and was investigated about five minutes after the fall. It was found to be quite hot. A scorching trail about three feet long was burned into the pavement.

The direction of the meteorite was from the constellation Aquarius, and about thirty degrees from the zenith.

As an account of this phenomenon doubtless will be of scientific interest, I am inclosing a photograph of it for publication if you wish.

Otis Ashmore.

Trail of meteorite burned into pavement

Did These Listings Help Other Readers?

Though it be delayed in reaching us, a kindly word is always appreciated. And so we hope Mr. Rosenberg understands that it is never too late to send in any comments on articles appearing in the Scientific American. He will be interested to see that we are publishing more radio listings in this issue.

Dear Editor:

I want to take this late means of complimenting you on your valuable publication of the various radio sets. This listing was appreciated by all of us, being the most concise and informative table that I have seen anywhere.

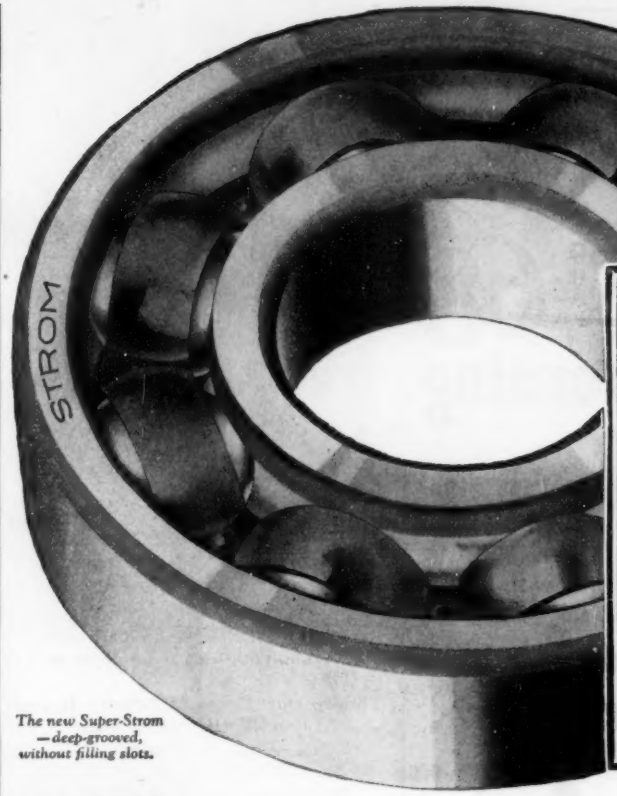
A listing of the various loudspeakers and phonograph units would be just as welcome, I am sure. It is one thing to get a hap-hazard listing and quite another thing to get an accurate listing with a reliable criticism such as you have given.

L. Rosenberg.

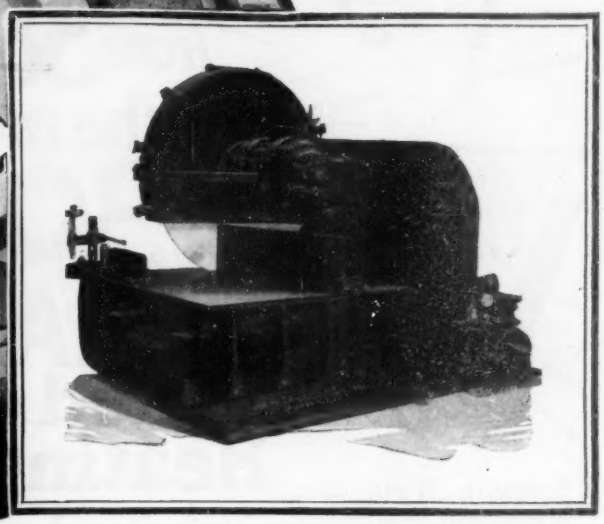
We Are Called "Great"

A brick-bat landed in the office the other day. Yes, Mr. Jameson, we know that Kimberley is in South Africa—not Australia—but then typographical errors will occur, even in the office of the Scientific American!

"Can it be that the great Scientific American' editor would be ignorant of the fact that Kimberley, the home of diamonds . . . is in South Africa! Fie, Mr. Editor, play the game!"



The new Super-Strom —deep-grooved, without filling slots.



Friction-saw, made by Joseph T. Ryerson & Son, equipped with Strom Ball Bearings, used for sawing steel I-beams, channels, angles, etc.

Single-acting thrust bearing, flat seats (grooved races) 1100-F Series

Double-acting thrust bearing, flat seats (grooved races) 2100-F Series

Single-acting, self-aligning thrust bearing, leveling washer, 1100-U Series

Double-acting, self-aligning thrust bearing, leveling washers 2100-U Series

In 55 seconds—

this Strom-equipped Friction-Saw cuts through an 18-inch Steel I-beam

FRICTION serves a useful purpose in the Ryerson Friction Saw, illustrated above.

The principle of operation is simple, consisting of a circular steel disc revolving at 1800 r.p.m. The edge of the disc is square — 3/16 inch to ½ inch thick — and nicked with a cold chisel. Friction between this edge and the metal to be cut generates sufficient heat to cause melting at the point of contact. The nicks of the disc carry off the melted metal.

In operation, the disc develops a peripheral speed of 20,000 feet a minute or approximately 225 miles an hour. End thrust and radial load on the armature shaft of the motor that delivers power are obviously heavy. Hence the bearings in the motor must be exceptionally sturdy.

Super-Strom Ball Bearings were selected for this purpose because of their proved dependability to carry extra heavy loads at uniform speed. They hold the shaft in permanently rigid alignment. They reduce friction losses to the minimum, insuring low starting torque in the motor—with notable savings in time and power.

All Strom Ball Bearings are made of special alloy steel hardened throughout — not merely case-hardened — thus providing uniform hardness with elasticity which results in exceptional durability. Retainers are unusually sturdy — accurately pressed, rigidly riveted. Scientific precision in manufacture insures much closer tolerances and much less eccentricity than standard practice.

There is a Strom of the exact type and size to fit your needs. And the new Super-Strom offers increased load-carrying capacity by the use of more or larger balls. Write for catalog and technical data. Our engineers welcome inquiries.

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Then remember that this unit has more than 5 times the efficiency of direct radiation; that it has the ability to heat up from 38° to 68° in 30 minutes in the morning; that it actually distributes heat over large areas and not in one corner or directly over the heater, and that it is considerably cheaper to buy and install than an equivalent amount of direct radiation.

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A combination of the solemn and the humorous—but an effective warning

Thinks Our Proposed "Stop" Regulation Worthy of a Trial

The Commissioner of Public Works for the State of Massachusetts has commented on Mr. Slauson's article in our April issue.

Mr. Slauson's articles on motor traffic have provoked many interesting comments. But as pictures often make an impression where words fail, we expect that the accompanying photographs, illustrating novel warnings will get all the consideration due them.

Dear Editor:

This is to acknowledge receipt of your letter of April 28th, together with copy of the April number of the Scientific American, including an article by Mr. H. W. Slauson, on "A New Plan for Traffic Laws," which I have read with a great deal of interest, and I appreciate your courtesy in bringing it to my attention.

I fully agree with Mr. Slauson's criticism of speed limits for regulation of motor vehicle traffic in cities and towns, and I opposed the bill before the Massachusetts Legislature fixing the limit of speed for such vehicles at 35 miles per hour, because speed should be controlled wholly in relation to conditions both of highway traffic and use of the road by pedestrians, which it is not easy to define in a law.

The "stop" regulation proposed by Mr. Slauson is very interesting and well worthy of a trial to develop its practicability. I will see that it is called to the attention of the Registrar of Motor Vehicles of this department for an expression of opinion and I will also give it further study myself.

William F. Williams,
Commissioner.

From Bad to Worse!

All of us have had some annoying experiences with traffic congestion. Therefore, the letter from Mr. Couch, which is very much to the point, is expected to evoke the sympathetic understanding of all who read it:

"I like your department for investments because it gives a reason why they are either good or bad. I would also like to see more about automobile traffic. We live 40 miles from Worcester, Massachusetts, and go to the theatre at Worcester, Massachusetts, every Saturday. In 1917 we bought a Ford car and it took us two hours to go the 40 miles over very poor roads. In 1924 we bought a 58 horsepower six-cylinder Auburn, which can go from 50 to 60 miles an hour. . . But now, although the roads are good, I have to pass so many other automobiles and lose so much time in driving carefully that it takes two hours to go the 40 miles to Worcester, just the same as in 1917.

"I do not understand why we pay taxes to build wide concrete roads, and although I paid five times as much money for this car as the Ford in 1917, yet we are going just the same as in 1917 or worse."

He who rides must read this conspicuous warning

Science and Money

Machinery of Investment Banking

Functions and Usefulness of the Investment Banker. Mechanical Details of Financing.

By Chase Donaldson

IN the year 1924 more than $6,327,000,000 in new securities were sold in the United States. The machinery of investment banking was called upon to distribute the greater part of this volume of financing. Investors, therefore, may well become curious as to the mechanical features of this operation, and as to the various kinds of financial service that these bankers can be called upon to perform.

The Service of the Bond Salesman

Possibly, the most obvious service—not always considered a service by the investor—is that afforded by the well-dressed bond salesman who calls at frequent intervals to cry his wares. But underlying these calls is the mass of details involved in the actual purchasing and selling of the securities offered to the public. And supplementary to the calls themselves is the staff of statisticians and analysts maintained by every investment "house" of any consequence. Particular attention should be drawn to the usefulness of these specialists to the investor, and to the desirability of checking the opinion of one group against that of another.

But before passing to this service of financial advice, it will clarify the subject of investment banking to outline first its major functions.

Functions of the Investment Banker

The first function of the investment banker is to aid corporations, municipalities, and even governments to secure funds for legitimate purposes and needs. The second function is to provide the investing public with an outlet for their surplus funds; in other words, to bring the buyer and the seller together. And the last function, which depends upon the performance of the first two, is to protect the best interests of both the seller and the buyer. The care with which this last obligation is exercised marks the calibre of the individual investment house.

The interests of a corporation, for example, are safeguarded by proper advice as to the time to sell securities to the public; by assistance in the determination of financial policies; by membership of a representative of the banking firm on the board of directors; by temporary loans or the arranging of credit to tide over a period of financial stringency; and by aid in negotiations with other corporations on such subjects as mergers, trade practices, and operating agreements.

How Investors' Interests Are Guarded

As to the investor who buys his securities through an investment house, his interests must be guarded in two ways. First, only such securities should be offered him as have been carefully passed on and analyzed by the banker. And second, close touch should be kept with the operations of the corporation to insure the proper protection for the securities sold.

Of more interest than the actual functions themselves is the complicated machinery that is necessary to exercise them. Behind the scenes of most banking houses, three major departments are to be found: the buying staff, the selling organization, and the advisory service.

Buying securities for resale to the public has become such a specialized branch of investment banking that nearly all houses have one or more specialists whose entire time is taken up with the investigation of issues. Engineers, auditors, and experts in particular industries are called upon to analyze all phases of the operations of applicants for financing. Of course, many requests for funds are based upon such insecure foundations that a preliminary examination is all that is required to produce a courteous refusal. It is doubtful, in fact, if more than one or two percent of the propositions that are submitted to the larger houses ever survive the "mill" or are offered to the public in the form of securities.

The care with which these examinations are conducted varies widely between the different houses, as do the standards required before acceptance of an issue. Reputation as a "conservative" investment firm harks back to the kind of issues that have been sold in the past, and to the character of the buying analyses made. These analyses cover, in general, such matters as past earnings and sales, financial condition and kinds of securities outstanding, standing of the industry and of the product, physical value and operating condition of the plant, sales and operating methods, organization and management, markets, and other related topics. In addition, the uses to which the new funds are to be put are subjected to close scrutiny.

What "Syndicating" Means

Sales of securities by an investment banker may either be at retail, direct to the investor, or at wholesale, to other investment houses, which in turn sell direct to the public.

Retail selling necessitates a sales manager as executive, and a staff of well-trained salesmen, each of whom has his own "list" of customers. Supplementary to the regular staff is sometimes found a regular training school for cub salesmen, where they are taught elementary investment principles, the "points" of particular issues, and the general theories of salesmanship.

Wholesale selling of securities, or "syndicating" as it is usually called, involves a jargon and a procedure that is unrelated to any other form of activity. The house which originates the issue may buy it outright from the issuing corporation, or may invite other houses into the business to share the risk, and the profit. This buying group then invites other houses into a selling group, so called, which in turn sells the securities direct to the public, or to smaller dealers, allowing them a dealer's commission.

The profit, or "spread" between the price at which the securities were bought from the issuing company and the price at which they are sold to the public is therefore divided into many parts. The originating house or houses, if it includes itself in all the groups, as is usually the case, makes the full spread or profit on the part of the issue it sells at retail, and an originating profit on its part of the issue turned over to the selling group. The others make profits proportionate to the amount of work done, or rather, proportionate to the group to which they are invited.

Functions of a Service Department

An advisory service has been found necessary by the larger firms to keep their clients informed on matters affecting their holdings, and to help them with their investment problems. Many people do not know when issues are called for redemption, when sinking funds operate, when rights to subscribe to additional stocks are given them, or even

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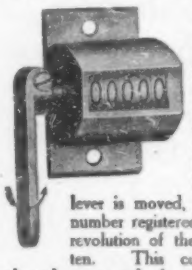
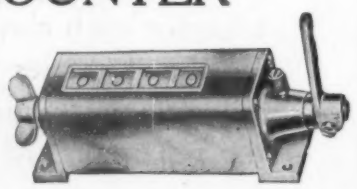
Veeder COUNTER

This Small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of many small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, $2.00. (*Cut nearly full size.*) Small *Revolution* Counter of similar model, also $2.00.





This large Re-Set Rotary Ratchet Counter records the output of punch presses, metal-stamping machines and others where a reciprocating movement indicates an operation. Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Provided with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50. (List.) Equipped with lock and keys to prevent tampering with the record, $2.00 extra. (*Cut less than half size.*) Set-Back *Revolution* Counter, $10. (List.)

The Veeder booklet is an 80-page guide on how to register an increased production at ANY machine. Sent free to all who may meet with the problem—in invention, engineering or manufacturing.

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.

when their bond issues are due and cease to pay interest. The routine operation of a service department is largely taken up with such matters as these.

Advice, however, is as important as this other more mechanical service. Many of these departments will analyze the securities that one owns, and suggest changes or switches to others that are more secure or that give a better yield. Usually, too, these departments are well experienced in recommending the proper diversification of investments between the different classes available.

But it is in the very advice of these service departments that there lie the possibilities of a mild form of exploitation. Each house has securities to sell, and is sometimes inclined to be more enthusiastic about those on its "list" than it is to recommend the securities sponsored by another investment house. This remark, however, applies largely to the new issues that appear on the market from time to time; on the standard investment issues that have a ready market and that have been dealt in for some time, the recommendations are usually quite impartial, and based entirely upon the statistical and earnings position.

As a measure of protection against the enthusiasm of any one house for the issues in which it is particularly interested, there is no harm in checking the recommendation of one service department against that of another.

Other Forms of Service

Still another form of service is performed by many of the houses. A custodian or trustee account is maintained in which are placed the securities of customers for safe keeping. Such a service attends to the collection of interest coupons, credits dividends to the customer's account when they are paid, and relieves the customer of the mechanical details of taking care of securities. Securities in such trustee accounts cannot be used by the investment house as collateral for loans, but must be kept entirely apart from all other securities. In this case, too, before one entrusts his securities to a firm for safekeeping, it is essential to check carefully the standing, credit position, and past performance of the firm.

Inheritance and income tax problems also are familiar ground for many of the investment house advisory services. These two fields are so highly specialized that one should make every possible use of any such free service.

Utilize the Knowledge and Advice Offered

One last comment should be injected on the difference between the various kinds of investment banking houses that are to be found. Specialization, again, is becoming increasingly evident, and individual houses are limiting themselves to particular classes of securities. Some handle only government and municipal issues; others sell only public utility securities; certain houses restrict their operations to real estate mortgage bonds; still others are known as railroad houses; and finally, a number of bankers are specializing in individual classes of industrials, such as chain stores, oils, motors, and even radio. The note of caution here is not to pin all of one's faith on any one type of security, or on a house that deals in only one class of investment; it might seem a wiser policy to seek specialized guidance from these houses, and to purchase the securities of each one in the proper proportions.

Although the machinery of investment banking has been in operation for many years, it is particularly since the war that the refinements outlined in this discussion have become manifest. And one particular point should have become evident from this description of the mechanical details; instead of merely watching the wheels go around, and buying a bond once in a while, the investor should avail himself of all the specialized knowledge and advice that underlie the operations of this vast and complex piece of machinery.

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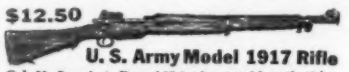

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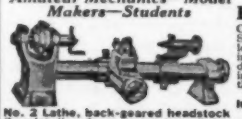

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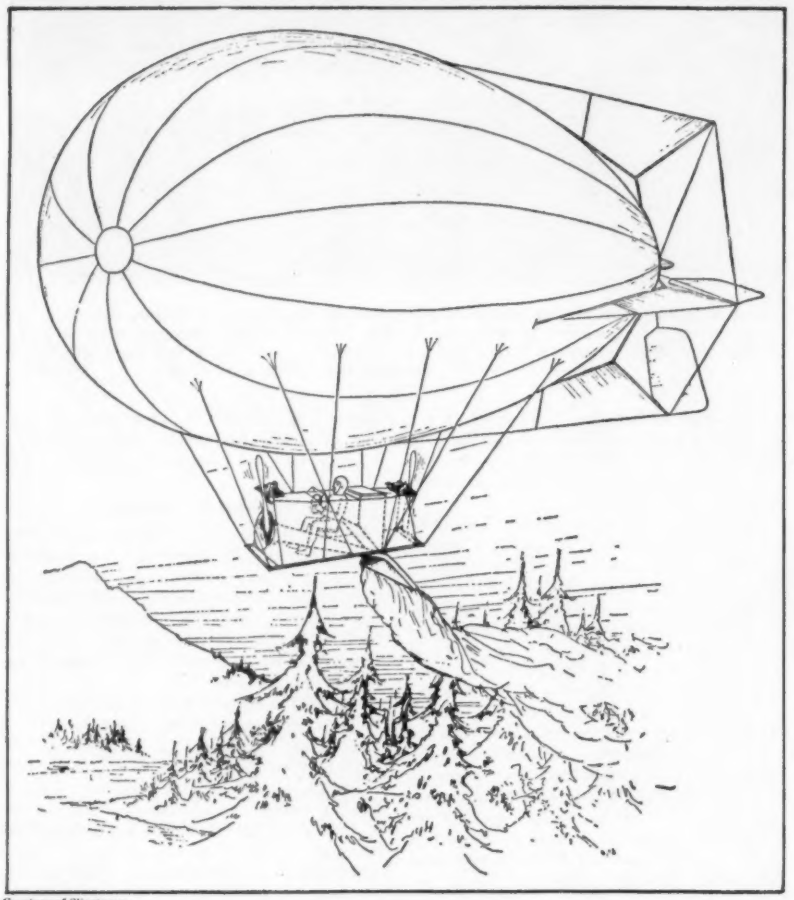


Courtesy of Slipstream

Type of dusting blimp showing latest type of dusting hopper. This blimp was sent east in 1923 to quell an outbreak of the "Gypsy Moth" in New England

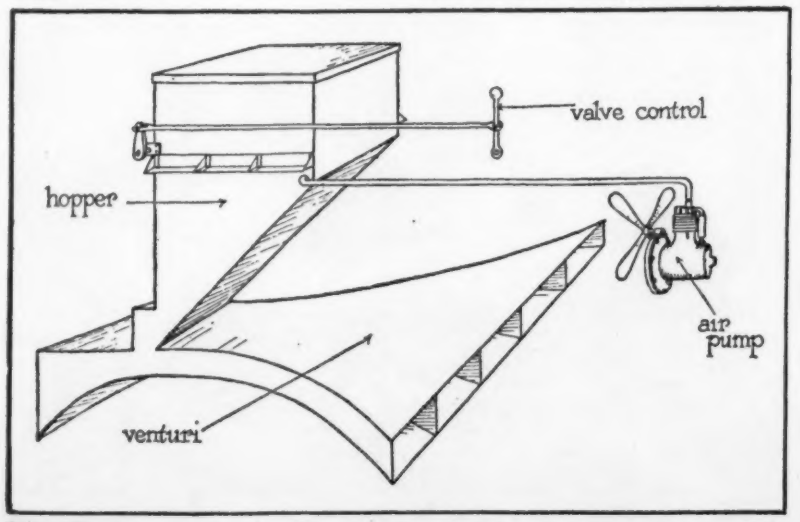
Poison Spraying

THE insect menace to agriculture only appeared when civilization destroyed nature's balance by the restriction or even destruction of bird life. It has now reached enormous proportions and is threatening the most important industry in the world, namely farming. The United States Department of Agriculture estimates the total annual loss as $1,556,869,300.

In *Slipstream* an authoritative article describes how the airplane and the dirigible have been brought into play against this stupendous evil.

For fighting the gypsy moth, over the thick forests of New Hampshire, a small dirigible has proved most practical—engine failure not involving immediate descent and in the appended diagram is shown a sketch of the latest type of dusting "blimp," equipped with a "dusting hopper."

In the airplane the dusting hopper is similarly disposed at the bottom of the fuselage. The airplane flies low, some fifteen feet from the ground, with the poison spray floating some distance behind. It might be thought that the propeller slip stream would scatter the spray in every possible direction.



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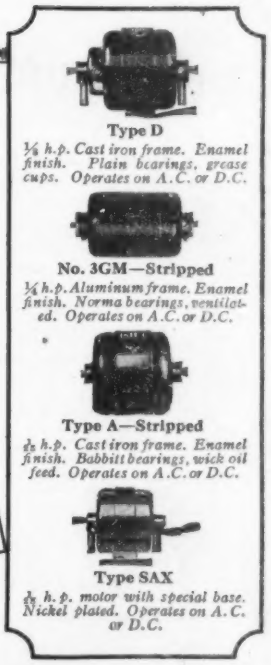
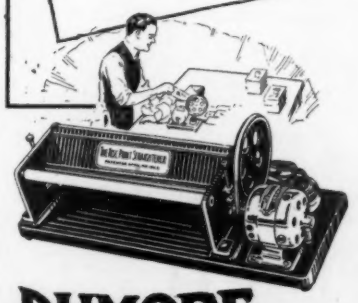


Type D
¼ h.p. Cast iron frame. Enamel finish. Plain bearings, grease cups. Operates on A.C. or D.C.

No. 3GM—Stripped
¼ h.p. Aluminum frame. Enamel finish. Norma bearings, ventilated. Operates on A.C. or D.C.

Type A—Stripped
⅛ h.p. Cast iron frame. Enamel finish. Babbitt bearings, wick oil feed. Operates on A.C. or D.C.

Type SAX
⅛ h.p. motor with special base. Nickel plated. Operates on A.C. or D.C.



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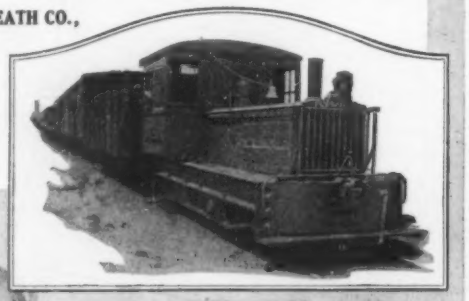
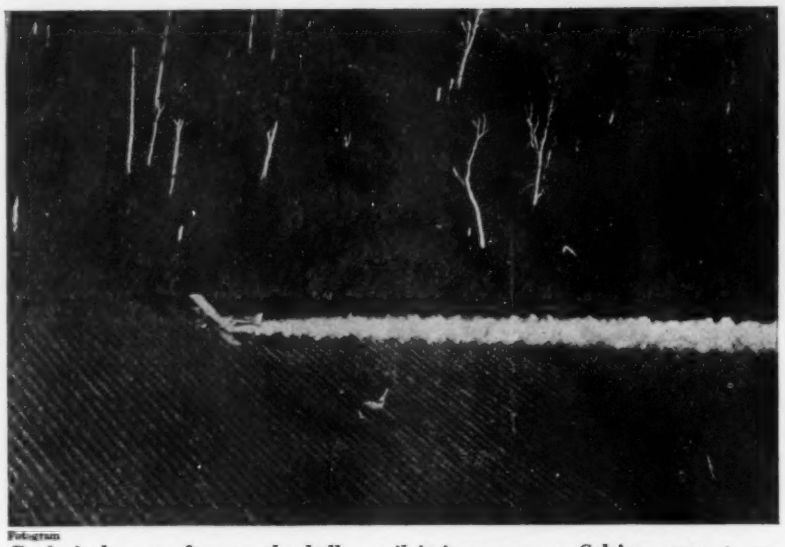


Plymouth 18 ton Gasoline Locomotive at plant of the Whitall Tatum Co., Manufacturers of Glassware and Druggists Sundries, Millville, N. J.

PLYMOUTH
Gasoline Locomotives



Fotogram

Real airplane warfare on the boll weevil is in progress. Calcium arsenate or other poison is forced into the crop by the 200-mile gale from the plane's propeller and thus creates a finer, more penetrating cloud than any land machine can make. The illustration shows how it is done

As a matter of fact the "downwash" of the air passing over the wings, and the charging with frictional electricity of the ejected particles, both lay the dust effectively and make it stick to the plants.

The hopper which has finally been successful is not, however, as simple a matter as might be expected. It is the result of much experimental work. The latest development is shown in the sketch. A tank or hopper carries the powder. From the hopper the powder drops into the throat of a venturi, where it is caught by the blast of the propeller and shot out in a ribbon-like cloud guided by air vanes in the venturi. To keep the somewhat sticky powder flowing uniformly compressed air is delivered to the hopper by a windmill-driven air pump at fifty or sixty pounds per square inch pressure. The flow of powder is regulated by a vertically sliding gate valve at the bottom of the hopper, actuated by push rods and bell cranks from the pilot's seat.

A Handy Lifeboat

THE MacMillan expedition for the exploration of the Arctic regions made the most careful preparations for its work. When the Loening Amphibians left their last base and sallied forth in flight over the unknown regions of the Northwest they carried every possible device to ensure safety—even lifeboats.

Unfortunately a plane provides little space or weight for a lifeboat. The Navy has accordingly devised an inflatable lifeboat which weighs but ten pounds and can be readily stowed aboard the smallest airplane. Lieutenant Commander R. E. Byrd, U. S. N., in charge of the flying end of the polar expedition, is shown in our photograph rowing ashore in his rubber lifeboat after a landing with the Loening Amphibian in the Potomac.

Steel-tube Airship

A GERMAN designer, Gustav Unger, who has been working on airship problems for many years, sends us a description of a novel design, in which duralumin channels have been replaced by chrome-nickel steel tubing of great tensile strength, and the structural design itself has undergone a radical modification.

One of the criticisms which may be made of the present form of rigid dirigible structure is that it is somewhat indeterminate in character; that is, the engineers cannot calculate its strength with as great an accuracy as they would like. Unger, who introduces a central, bridge-like backbone into his trussing, claims that his design is more determinate and calculable. It is interesting to compare the structure of an ordinary dirigible such as the *Shenandoah*, with the frame diagram of the Unger project.

Unger's design provides first of all a rigid longitudinal member running the entire length of the ship at its center. On this longitudinal member are fastened a series of transverse frames, which determine both the outer and the inner form of the ship. These transverse frames have a central part in the form of a cross, with the cross arms suitably stiffened, and a circumferential ring forming part of the frame. These transverse frames are connected together by longitudinal girders on the circumference. All connections are obtained by welding.

The frame is said to be not only more exactly calculable but as a consequence

National Photo

The ten-pound lifeboat used on the MacMillan Arctic Expedition. This rubber boat when inflated by a hand pump weighs only ten pounds, including the oars, but will support 750 pounds

Cruises to the Caribbean

GREAT WHITE FLEET Cruises —and there are two sailings every week in the year from New York and New Orleans—have won a world-wide reputation on account of the generous hospitality extended to Tourists.

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lighter for a given strength and volume of ship, the greater specific gravity of the steel being compensated for by the very thin gage employed.

A central keel at the bottom of the ship, over 300 feet in length; provides ample passenger space with comfortable sleeping quarters and a well distributed load. The disposition of the motors is novel, ten being placed along the center line of the dirigible, five on either side, and two being placed at the bow and stern end of the keel respectively. The disposition of the motors at the center line of the dirigible is intended to relieve propulsive strains on the airship. Ventilation of the gas cells is provided for by special air passages.

One of the obvious disadvantages of this type of construction may be the increase in the number of gas bags, since the transverse frames subdivide the interior volume into four times as many parts as in an airship of ordinary construction. Also the placing of the motors so high up may lead to a higher center of gravity than is desirable, and to difficulties in the fuel system and piping. Therefore, while the Unger airship is worth thinking of, its practicability still remains to be proved.

High-speed Wind Tunnels

E. HUGUENARD, writing in *La Technique Aéronautique,* discusses the problem of high-velocity wind tunnels in which experiments with air speeds approaching or equal to that of sound are possible. The study of the resistance of artillery projectiles is, of course, bound up with air speeds two or three times as great as that of sound. But is the problem a purely academic one as far as aerial navigation is concerned? Not at all academic, says M. Huguenard.

To begin with the tips of large airplane propellers rotating at 2,000 revolutions per minute and more, are already subject to air speeds of 600 to 700 feet per second. Secondly, while in the first airplane flights 30 miles per hour was considered a high rate of speed, the record now stands at 275 miles per hour, and the speed record has practically doubled every five or six years with no apparent break in the graph. Again, navigation at high altitudes where the density of the atmosphere is so much less than at ground level with a corresponding decrease in resistance is only being discussed. It may pass from the stage of discussion to that of actuality, and 500 miles an hour may become a possible figure for engineers to aim at.

Shock and sound waves for a 75-millimeter shell in an air stream of 1,450 feet per second

M. Huguenard conceives the possibility of the propeller disappearing and the reaction principle of propulsion, similar to that on a rocket being employed. We think he has at any rate made out his case fully for the present utility of the high-speed tunnel and proved that his experiments are of a valuable pioneer character.

In the ordinary wind tunnel a fan or a propeller moves a current of air through a channel or tube, either from one end of a large hall to another, or else forces it to circulate round and round in a closed path. In either case the kinetic energy of the air varies as the square of the speed, the amount of air moved varies as the cross-sectional area of the channel and as the speed of the air. Therefore, the energy to be expended in moving the air varies as the cross-sectional area of the channel multi-

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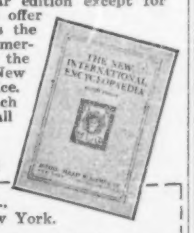

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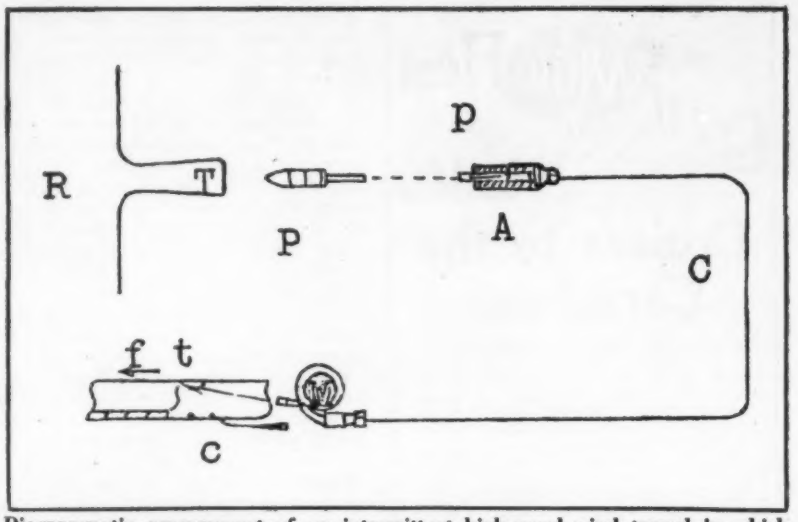

Diagrammatic arrangement of an intermittent high-speed wind tunnel in which tremendous velocities are obtained by discharge of air from a tank at high pressure, and resistances of a projectile are measured instantaneously

plied by the *cube of the speed*. And the horsepower of the motor required also varies as the cube of the speed. Hence, at very high speeds, the power required becomes fantastically large. For example, if the wind tunnel channel were small, only 20 inches in diameter say, and the air were to be circulated at 1,650 feet per second, we should need 15,000 horsepower with the most efficient type of wind tunnel yet designed. This would be economically beyond the reach of even the most scientifically minded government.

M. Huguenard has conducted his experiments by the application of a totally different principle, namely the principle of measuring resistance in an intermittent current of air. The apparatus is indicated diagrammatically in the sketch. The *Compagnie Parisienne de l'Air Comprimé* employs one of the largest air compressors in the world, one of 15,000 horsepower. This was utilized to fill a large tank with air at very high pressure which could be discharged rapidly through the converging and then diverging exit cone. The projectile or other body to be tested was placed at P, and the thrust on the body was communicated to the piston p of the dynamometer which compressed the oil in a tube C, terminating in a metal recording manometer. The measuring period of the system was about 1/50th of a second, so that experiments could be very rapidly conducted. The results checked up with the experiments conducted in artillery observations.

Propeller tips traveling at very high speeds are now known to be inefficient. M. Huguenard's experiments provided a visual explanation of this phenomenon also. At very high speeds the air no longer flows in the usual streamline fashion round aerodynamic bodies. There are formed distinct shock

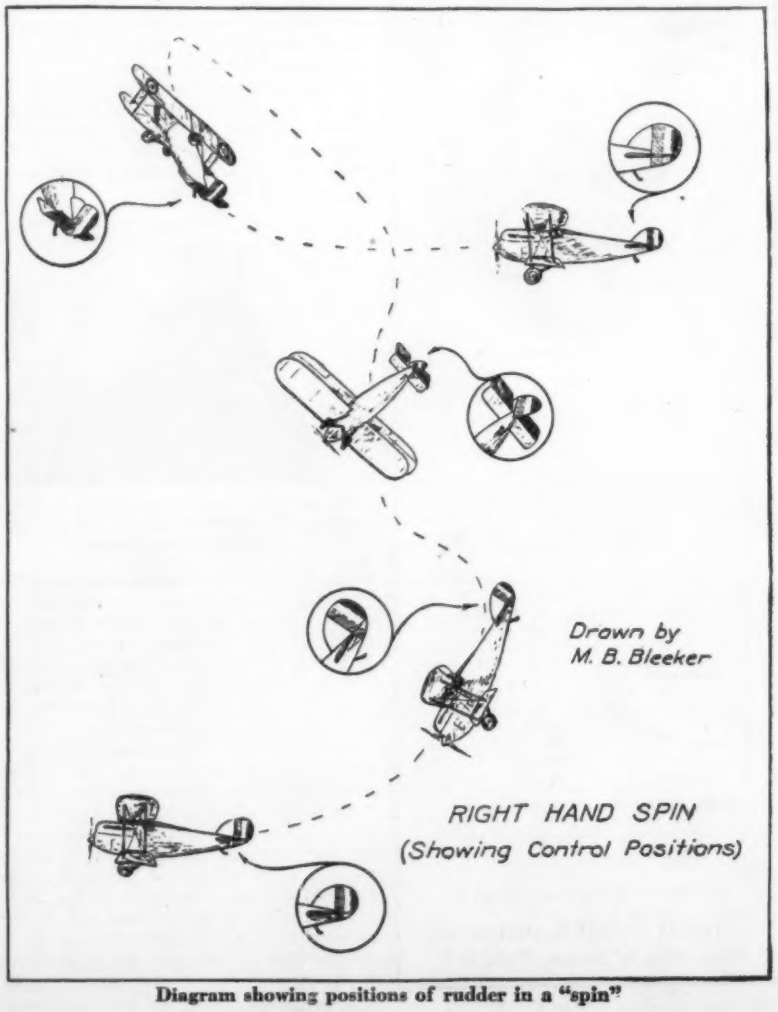

Diagram showing positions of rudder in a "spin"

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What is Spinning?

BECAUSE stunting is dangerous and to be avoided in ordinary flying does not mean that the commercial pilot should be ignorant of aerial acrobatics. On the contrary, he should be just as familiar with "aerobatics" as the military pilot, so as to be able to extricate his machine from any involuntary maneuver of his craft.

Strange to say, after all the years of experience that pilots have had in stunts of every imaginable character, airplane maneuvers are still not very exactly defined. Pilots execute maneuvers and come out of all sorts of peculiar flight attitudes more by rule of thumb and instinct than by perfect understanding of all the movements involved.

Anyone who has been in a stunt and has seen the sky and the earth whirl round him in wild confusion will understand how difficult it is to set down in words and diagrams the rapid evolutions and changes in the positions of the controls. Therefore, when an experienced and scientific pilot like Thomas Carroll gives his version of "spinning" in *U. S. Air Services* anyone interested in aviation is thankful to him.

The sketch we append herewith illustrates Mr. Carroll's view of the maneuver. The airplane is first shown in normal flight in the top right-hand corner of the diagram. The pilot pulls back as hard as he can on the control stick, raising his elevators as far as they will go. This raises the nose of the airplane violently and the machine is "stalled" or brought beyond the angle of maximum lift and beyond the range of normal flying. After the stall, the tendency of the airplane is to nose down violently. If, simultaneously with the raising of the elevators the rudder is turned as shown in the top left-hand corner of the diagram, the airplane not only noses down but tends to turn also and very soon a movement results in which the center of gravity of the airplane moves in a downward helicoidal path, while the airplane itself turns or spins about some rather ill-defined axis in its structure. The ailerons do not seem to play any great role in this maneuver. Throughout the spin the airplane is maintained at an angle beyond the angle of maximum lift to the path of the motion.

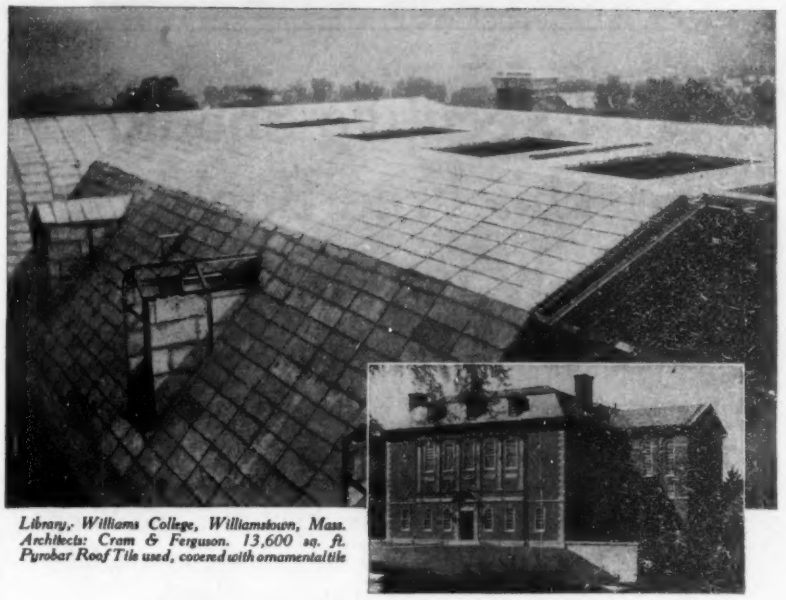
Recovery from the spin is now generally and thoroughly understood. The proper thing to do is to neutralize all controls, thus stopping the rotation. The airplane then goes into a straight dive, picking up speed rapidly and, from a simple dive, recovery is either automatic or very simply obtained by the use of the elevator. The danger lies in lack of altitude to permit recovery or in the tendency of the pilot to try and pick up the nose of the ship instead of letting the dive take its course. Or else, in the confusion, the pilot may bring the ship out of a spin in one direction only to throw it by artless manipulation of the controls into another spin. To a well trained man with a good ship these dangers are not serious.

The Future Commercial Airplane

THE National Air Transport Company, the newly formed $10,000,000 airline, has purchased ten Curtiss *Carrier Pigeons* for use between New York and Chicago. This is probably the largest order ever placed for commercial planes in the United States.

The *Carrier Pigeon* is designed for the requirements of night flying across the Allegheny Mountains, and has a landing speed of less than 50 miles per hour, which will be a great help in emergency landings. Equipped with a 400-horsepower Liberty motor, the plane can carry 1,000 pounds of package or mail matter at a maximum speed of 120 miles per hour. The pilot's seat is well behind the wings and the very stoutly built cargo compartment, giving a measure of protection in a crash, and his vision fore-and-aft is scarcely obstructed.

But while the Curtiss Company expects more orders for this type of plane to amounts



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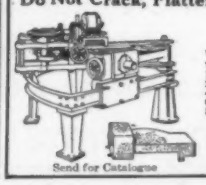

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aggregating between $2,000,000 and $3,000,000, Howard E. Coffin, president of the National Air Transport, after a survey of European conditions, predicts three-engine planes as the air carriers of the future? Their added security against power-plant failure is an overwhelming advantage and such European companies as the Royal Air Dutch Lines of Holland, the Imperial Airways of England, the French Air Lines from Paris to Constantinople are all testing or putting into service multi-motored giants of the air.

Flettner's Rotor Patent

WHEN Anton Flettner, as a result of much aerodynamic experimentation with sails, conceived the idea of utilizing the transverse force of a cylinder, rotating in a stream of air, for the propulsion of ships, he took out a very interesting patent in which many applications to aircraft are indicated. One of his ideas, already mentioned in these columns, was to use a rotating cylinder as the sustaining element in lieu of a wing. The efficiency or lift over drag ratio of a rotating cylinder is not very high however—the air is disturbed somewhat too violently for smooth flow.

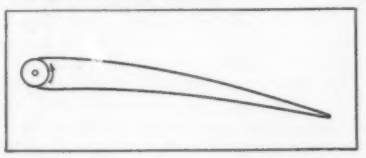

Figure 1. A rotating cylinder placed at the forward edge of the wing increasing the circulation round the wing and the lift

In his patent Flettner indicates what is perhaps a more promising line of approach. In modern theory the lift of a wing is explained by the combined action of the forward movement of the wing and a circulatory flow round the wing. Flettner conceives the possibility of increasing the circulation artificially by imparting a suitable movement to the surface of the wing, thus increasing the lift.

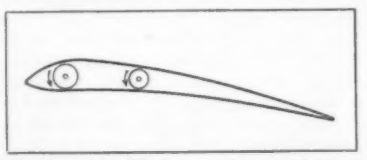

Figure 2. Two rotating cylinders placed within the wing to increase the circulation and the lift

A number of methods of increasing the circulation suggests itself. Thus, in Figure 1 we have a cylinder rotating at the forward edge of a wing; in Figure 2 two cylinders are placed within the wing surface; another idea is to have the surface of the wing comprise a species of belting, so that the entire surface is made to increase the circulation by surface friction or drag. It is impossible to say how promising these suggestions are. They are at least plausible.

Interconnected Aileron and Elevator

"AVIATION" briefly describes a patent taken out by a Dayton man on a system of interconnected aileron and elevator control. When the joy stick is pulled back the elevator is raised as in normal practice and at the same time both aileron flaps are lowered. Lowering the aileron flaps has the effect of increasing the lift of the wings, which is desirable in landing or getaway, but also moves the center of pressure forward so that the machine tends to rise by the nose. The simultaneous action of the elevators prevents this nosing up which might be greater than desired by the pilot. For lateral control, sideways movement of the joy stick gives the usual opposed action for the ailerons.

The disadvantage of the device lies in the fact that when the elevator is worked by the pilot, the flaps on the wings come into action whether he wants them to work or not, and this might not always be convenient.

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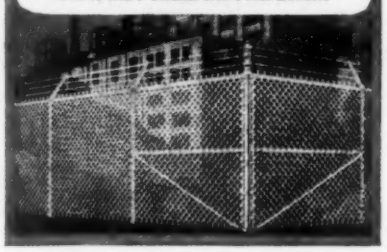

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Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Kadel and Herbert

The power units of the Daventry station, 5XX, England's new super-power station. Two huge masts, 500 feet in height, support the antenna of the station which is itself 600 feet above sea level

Radio Service Foundations

THERE are two general theories on which the broadcasting service of a country can be developed, according to Dr. Alfred N. Goldsmith in his report on allocation of wavelengths to prevent interference, in the Year-Book of Wireless Telegraphy and Telephony.

"One plan may be termed a resort to individual initiative," said Dr. Goldsmith. "According to this plan, those who desire to broadcast are permitted to do so with a minimum of governmental control. Alterations in their service, changes in wavelengths, or in methods of transmission, and the like are freely permitted. Rapid progress is thus made at the cost of some confusion in the earlier stages of development. There are also likely to be unnecessarily large numbers of broadcasting stations for which no real justification exists under such a regime.

"The other plan might be termed the resort to systematic planning and control. Under such a plan, some large organization, in command of the broadcasting situation, and in general, the Government, will lay out as nearly an ideal arrangement of broadcasting stations as it can. Localities, wavelengths, hours of operation and even program material will be planned in as great detail as possible. An orderly and smoothly functioning system is thus produced, but progress is somewhat hampered, and radically new discoveries do not fit into such a plan nor do they receive particularly sympathetic encouragement. Much can be said of either system, and it will presumably be on the basis of the temperament and tradition of each people that they will determine the system they prefer."

Famous Station to Be Dismantled

ONE of the old landmarks of wireless, at Clifden, Ireland, is to be dismantled. It was one of the first stations to establish regular communication with America on the 7,000-meter wavelength. Its 300-foot steel towers were heralded, at the time of their construction, as one of the achievements of the age. The advance of radio has made most of the Clifden equipment obsolete and more modern stations are handling the traffic across the Atlantic.

To Modify Calls

THE International Telegraphic Union at Berne is endeavoring to modify all call letters that have a resemblance to the distress call SOS. Some calls such as SSO, VGI, SOR and SMD when transmitted fast sound like SOS and have been known to lead to confusion.

New Set at Arlington

THE Navy's radio reservation at Arlington, Virginia, has a new 500-watt radiophone transmitter, operating on 435 meters. It will be used by the various departments of the Government in disseminating information, market reports and weather forecasts. It is rated as a class B station and uses the call NAA.

How to Avoid Hums from Power Lines

ALL radio antennas should be erected at right angles to all other wires, and the reason is clearly explained by the Canadian Department of Marine and Fisheries. It is pointed out that all electrical conductors are surrounded by an electromagnetic field. When the current changes, the electromagnetic field changes and induces a voltage in any near-by antenna. There is also an electrostatic field surrounding wires carrying high voltages. A change in this field also induces a voltage in an antenna close by. These fields do not generally extend more than a few yards from the power wires, but in some cases where a change of current or voltage is of a sudden nature, called an electrical surge, an antenna a considerable distance away may be affected. This is called inductive interference.

An electrical surge may travel many miles along a power wire, and produce a radiation which is likely to be detected by radio receivers. For this reason the antenna should be placed as far as possible from the wires and at right angles, because the induction is much greater when wires run parallel. In no case should an antenna be erected above and crossing a power line, because, if it accidentally fell it would make contact with the high-voltage wires. Numerous deaths have resulted because of antennas which dropped from their masts on power wires.

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Tests Made at KDKA

EXPERIMENTS at KDKA indicate that a low aerial on a hill is more efficient for transmitting than a high aerial located in a valley. The tests were made in connection with changing the broadcasting installation from its original home, atop a nine-story building in East Pittsburgh, to a new site on a hill a mile from the old station. It was also found that signals radiated from the low antenna on the hill did not fade as much as those broadcast from East Pittsburgh, and they reached distant cities with greater volume.

Atop the World

OVER 200 broadcasting stations use slogans and they are helpful in identifying transmitters when the call letters are missed. One slogan has been a puzzle to many listeners, because they had no idea what station was "On Top of the World." Some believed it to be Denver, Colorado, because of its high altitude, but a letter from CJCM, Mont Joli, Quebec, reveals that CJCM is "On Top of the World."

WGY to Extend Its Wire Lines

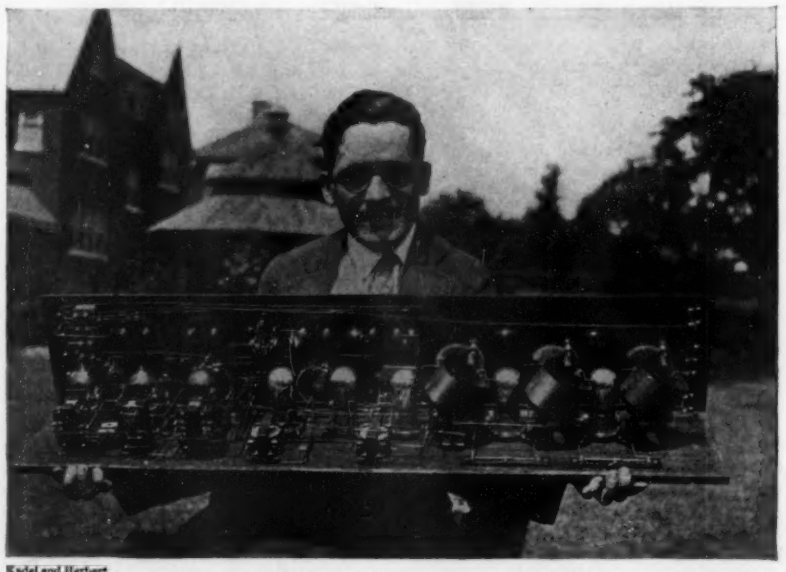
PLANS are being made to have the transmitter of WGY, Schenectady, connected by land wires with Rochester and Syracuse so that programs can be picked up at those points. Educational broadcasts will be radiated from Syracuse University, also athletic contests. It is probable that musical programs from the Eastman School of Music at Rochester will be sent over the wires to WGY.

News Background for Radio Talks

BRITISH program impresarios are striving to make all broadcast talks of timely interest by giving them a news background. The news field is being mapped out under headings such as politics, sports, transportation, shipping, travel, geography, geology, history and a host of other subjects. The plan is to have an expert on each topic appointed. For example, if an earthquake occurs in some part of the world, an expert on the geography in the particular region will be called on short notice to prepare a lecture based on the news and then broadcast it, while fresh and under discussion.

Fifty-kilowatt Station

THERE are reports that a super-power broadcasting station, with a power input of 50,000 watts, will be placed in operation about October 1st, by the Radio Corporation of America at Bound Brook, New Jersey.



Kadel and Herbert

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Static an Obstacle to "Talk-bridge"

TELEPHONE engineers in the United States and England are obtaining necessary data on which to plan a practical radiophone "talk-bridge" across the Atlantic. During the past two years 40,000 observations have been made relating to the many factors involved, including static and absorption of the waves by sunlight.

The work has been carried on in this country by the American Telephone and Telegraph Company and the Bell Telephone Laboratories with the cooperation of the Radio Corporation of America. In England the International Western Electric and British Postoffice have been jointly engaged.

The measuring apparatus which records the incoming signals and strength of static is located at Riverhead, Long Island; Belfast, Maine; New Southgate and Chedzoy, England.

A report on the tests said, "From the standpoint of the subscriber using transatlantic telephone service the primary question is whether or not he can readily understand and be understood. The variation in transatlantic transmission is expressed directly in terms of percentage of words understood. It should be borne in mind that these intelligibility tests are carried out by speaking a series of entirely unrelated words, so that there is no thought context to aid in their correct reception. Such a test is therefore severe."

It was found that during the evening hours at the English receiving station, when the sunset line is in the Atlantic Ocean, so that transmission is occurring through the twilight region separating day and night, reception is poorest. Under these conditions the percentage of words understood was found to be practically zero. The engineers pointed out that this does not mean that during these hours successful transatlantic conversation cannot be carried on. It means that at that particular season and under the conditions of the test it could not have occurred. During this test the power delivered to the aerial was 68 kilowatts. A loop antenna was used for reception. It was evident that greater power would be necessary for successful transoceanic radiophone service.

Study of the noise picked up by the receiving stations in this country and England, particularly the noise from hour to hour, point to interesting conclusions as to the dominant source of static which influences the reception of the high wavelength signals. An analysis of the observations extending back over two years indicates that the noise picked up in England on the long wavelengths originates largely in equatorial Africa.

Thus, a low noise level at the receiving station is found to correspond to daylight extending over most of the continent of Africa and also the regions separating England and Africa. Since daylight transmission is much poorer than nighttime transmission, it seems likely that the waves of static spreading out from Africa are much attenuated before reaching England. When darkness envelops the entire region, marked attenuation caused by daylight conditions is absent and the waves of static penetrate through to the English receiving stations without much absorption.

One of the interesting results of the study of thousands of individual observations is evidence of a certain correlation between the strength of signals received across the ocean and any unusual variations in the earth's magnetic field. Abnormal transmission occurs during abnormal magnetic changes.

Engineers say that, if there were no such things as static and absorption by the sun, transatlantic radiotelephony would be a simple matter. Yet the requirements imposed by commercial telephone service are rigid, not only because satisfactory communication must be provided any hour of the day and any day of the year, but also because transoceanic radiophone must operate in conjunction with land telephone lines in the United States and Europe. Radio

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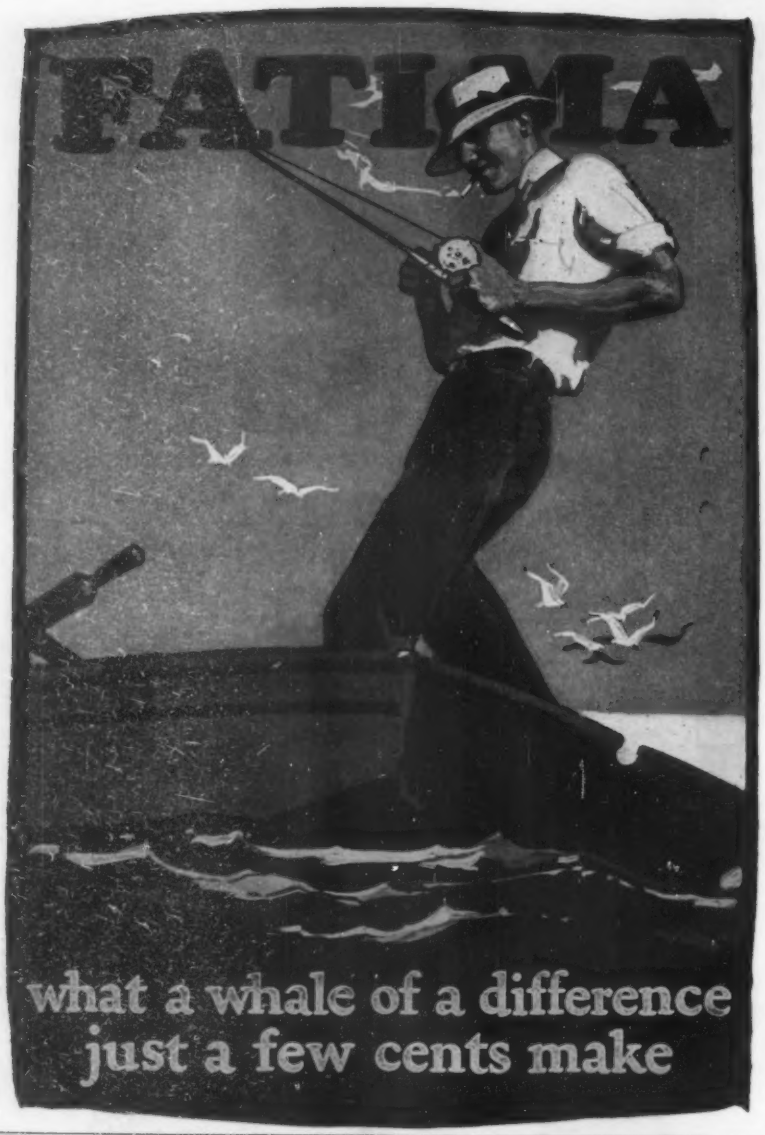


is but a link in a long telephone circuit. Thus, when a subscriber calls from New York or an inland city his voice will travel by wire to the radio transmitter on the Atlantic coast, thence by radio to the receiving station in England, from which point it will again travel to the party who is being called.

Chamber Music Concerts

PLANS are being made to broadcast the concerts from the new music building, which is a part of the Library of Congress, at Washington. The auditorium is the gift of Mrs. Elizabeth Sprague Coolidge, of Pittsfield, Massachusetts. An endowment is included which will reach $25,000 a year. It is expected that the first concert will be broadcast late in October. Only artists consenting to have their music broadcast will be engaged and all artists will be paid.

The programs will feature chamber music, "a name applied to that class of music which is especially fitted for performance in a room as distinguished from concert music, requiring many performers." In practice, chamber music is generally rendered by a string quartet, with, frequently, the addition of a piano, flute, clarinet, oboe, flute, horn or other wind instrument. Mrs. Coolidge expressed the wish that preference be given to "the composition and performance of music in ways which might be considered too unusual or too expensive to be ordinarily undertaken, giving precedence to consideration of quality over those of quantity, of artistic over economic values, and of opportunity over expediency."

It is reported that the broadcasting will be done by a chain of stations linked together by land wires, and it is hoped eventually that the concerts will be heard from coast to coast.

Rural Pennsylvania Has 10,378 Sets

THERE are 10,378 radio sets in rural Pennsylvania, according to the first triennial census conducted by the State Department of Agriculture. The survey showed that radio is most popular with the farmers living in counties bordering Philadelphia and Pittsburgh.

16,000 Receivers in Switzerland

SWITZERLAND now has 16,000 radio receivers according to the registration recently completed. There were only 980 sets in that country in 1923.

More Volume From 2LO

STATION 2LO, London, has a new aerial. After the first tests of this aerial the office was bombarded with telegrams reporting as high as 50 percent increase in intensity.

New Compass Stations

RADIO compass stations have been installed at Point St. George, California and at Eagle Harbor and Grand Maris, Michigan.

How Much is Super-power?

ELECTRICALLY speaking, the combined power of all the broadcasting stations would not make what electrical engineers term "super-power." J. R. Freed, President of the Freed Eisemann Radio Corporation, points out that no less than 125,000,000 kilowatt hours of electricity are consumed each year. About half of this is produced and used in the United States, and 80 percent of this power is used in industry.

"There are in the United States and Canada 106 lighting, power and electric railway companies, having a yearly output, each of 100,000,000 kilowatt hours. The Niagara Falls Power Company in 1924 reached 2,858,482,674 kilowatt hours. The Commonwealth Edison Company and the Edison United Companies of New York give peak loads in kilowatts of 717,000 and 615,283, respectively. Thus it will be seen that we are far away from the era of super-power broadcasting."

Government Coordinates Its Radio System

THE cost of departmental communication of the Government was reduced $1,000,000 during the past year, through the coordination and practical application of army and navy radio stations, and government leased wires. This saving was initiated by Director of the Budget, Lord, who invited the attention of every government department to the facilities available. As a result the army radio net sent 100,000 messages during the first seven months the plan was in effect, thereby establishing a new record.

There are 165 stations operated by the Army Signal Corps, sixty of which are placed in local corps areas, 17 departmental stations and 23 in Alaska.

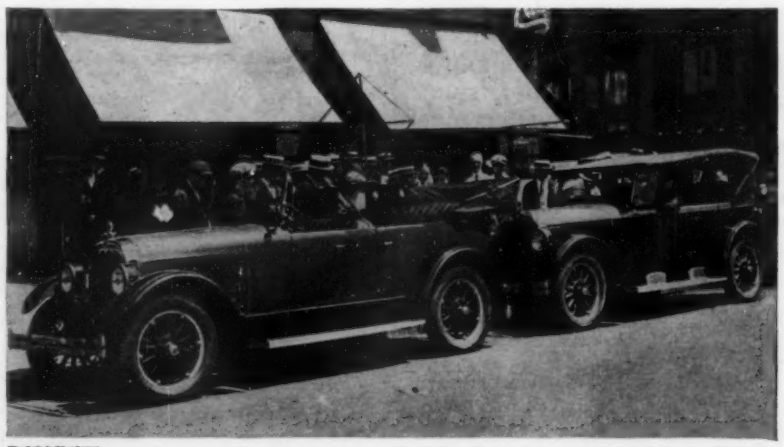
As part of President Coolidge's policy of economy a conference was called of all government activities operating communication agencies and the preliminary study showed that the Army, Navy, Agriculture, Post Office, Treasury, and Shipping Board had certain facilities that might be coordinated.

Equipment on the *Shenandoah*

THE dirigible *Shenandoah* has a new radio equipment with sufficient power to cover 9,000 miles. It weighs 1,600 pounds and consists of two distinct units. First, a main transmitter operating on different wavelengths varying from 500 to 1,500 meters. The second set is a short-wave installation, incorporating both radiophone and continuous-wave telegraphy. The telephone is employed chiefly for landing operations.

The antenna is let out from a reel below the ship by means of weights and pulleys.

The airship has three receiving sets; a long-wave, seven-tube circuit, capable of tuning from 2,000 to 20,000 meters; a short-wave set, covering the wave band from 150 to 2,000 meters and a six-tube set to cover from 500 to 19,000 meters in conjunction with the radio compass.



Kadel & Herbert

An interesting radio experiment under consideration involves the crossing of the continent by two automobiles, one controlled entirely by radio and the other the guiding unit. In the control car there is a special radio transmitter, tuned to 80 meters and radiating 100 watts. The various controls of the automobile are operated by relays actuated by the transmitter and no specific human agency is required in running the car

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Notes and Queries

Conducted by Albert A. Hopkins

This department is intended for queries of general interest. Only a small percentage of the queries we receive can be printed here, the great majority being answered by mail. Except in special cases we cannot solve mathematical problems, give directions for building machinery or answer queries of a special nature which belong within the sphere of the professional engineer. All queries must give the name and address of the inquirer and must be accompanied by return postage. In writing about book orders or subscriptions please use separate sheets, give your name and address on each.

The Spanish Prisoner Again

During the years 1888 to 1903 the x + y problem occupied the interest of a considerable number of those interested in trick solutions. As it was apparently this to which our correspondent referred, we gave in our March issue one of the shortest solutions, called the "Spanish Prisoner."

So much interest has been evinced and so many questions have been received in reply that we have not been able to cover them in detail, so give the following general solution:

May 1, 1925.

The Editor,
Scientific American,
New York, N. Y.

Dear Sir:

In your March, 1925, issue, you published a solution of "The x + y Problem." The only values determined were the integral values of x = 3 and y = 2. Moreover, the manipulation of the equation ab — b = 4 depends upon a fallacy since no definite unique values of ab and b can be determined from this equation alone. We can assume any value we wish for ab and b will be this value minus 4. The values ab = 5 and b = 1 do lead to a correct solution of the original equations but these values are not unique values for the equation ab — b = 4. Suppose that in place of the equation $x^2 + y = 11$ we had $x + y = 10$. How could the solution then be found by the published method?

I have made a complete solution of the simultaneous equations $x^2 + y = 7$ and $y^2 + x = 11$. This is the same problem except for the interchange of the constant terms. In place of the interchange of the constant terms we may consider that x and y are interchanged.

I am enclosing the solution with a sketch and I hope that you may publish it for the information of your readers who are interested in the problem.

Very truly yours,
(Signed) OSCAR S. ADAMS,
Geodetic Mathematician,
U. S. Coast and Geodetic Survey.

General Solution of the x + y Problem

Let us start with the equations:

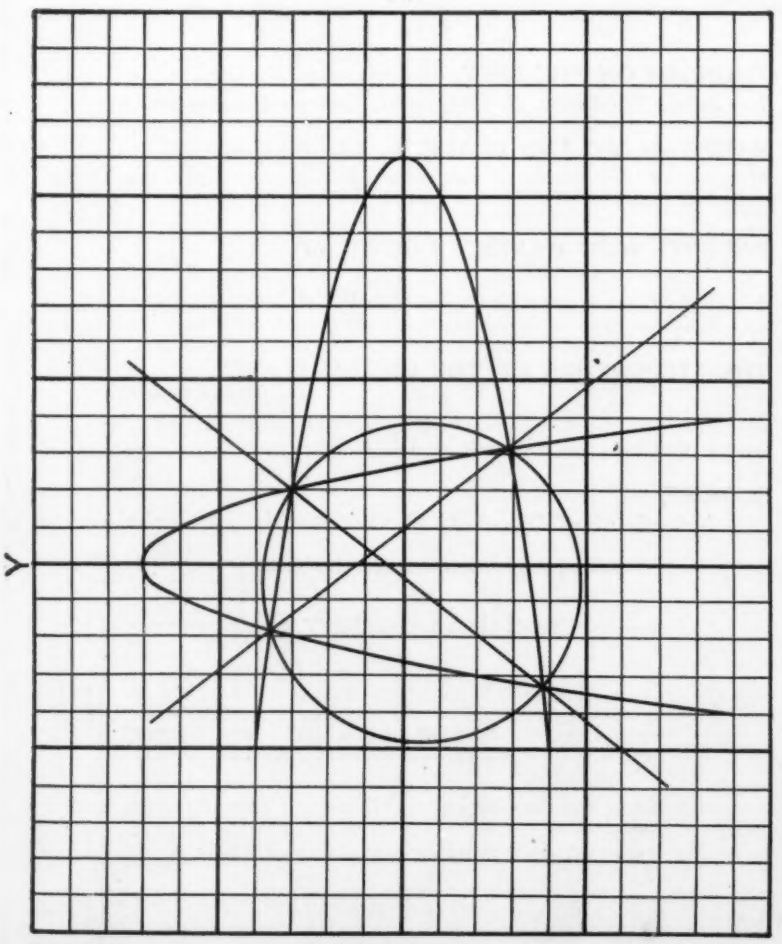
$$x^2 + y = 7$$
$$y^2 + x = 11$$

These equations represent two parabolas situated as shown in the illustration. It is evident from the figure that there are four real points of intersection. By adding the two equations we get

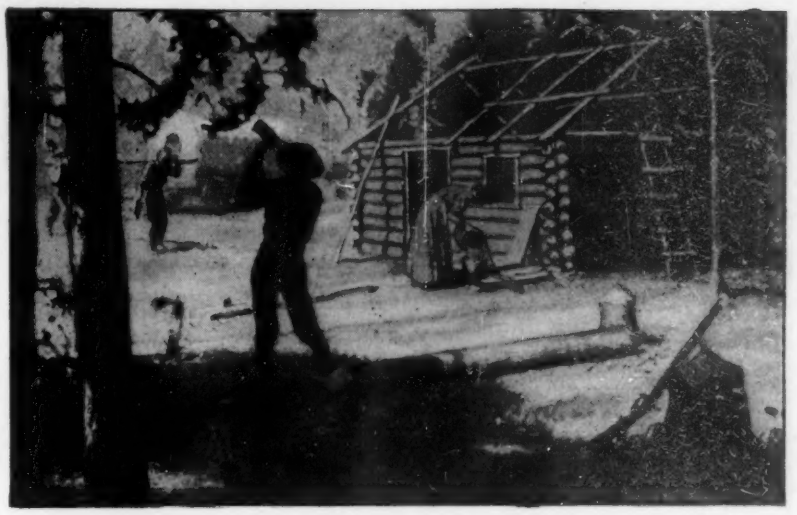
$$x^2 + y^2 + x + y = 18.$$

This equation represents the circle that is shown in the illustration. The four points also lie on this circle, since when the two

(Continued on page 285)



Diagrammatic representation of the various equations, showing their conjunction at four points



Building for America's growth

The early builders of America made their houses of rough hewn logs or of stone or adobe lifted from the earth. Settlements grew to towns, towns to cities. Small stores and shops were built, and these in turn were torn down to make room for bigger ones. Roads, bridges and railways were constructed. Factories and skyscrapers were erected. And so, swiftly, the America of today appeared, still growing.

In the midst of the development came the telephone. No one can tell how much of the marvelous later growth is due to it—how much it has helped the cities, farms and industries to build. We do know that the telephone became a part of the whole of American life and that it not only grew with the country, but contributed to the country's growth.

Communication by telephone has now become so important that every American activity not only places dependence upon the telephone service of today, but demands even greater service for the growth of tomorrow.

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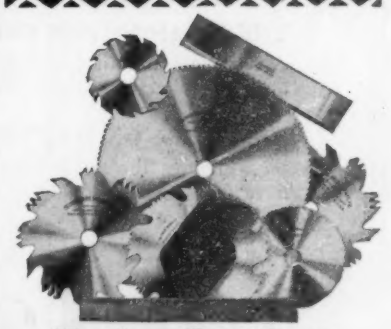

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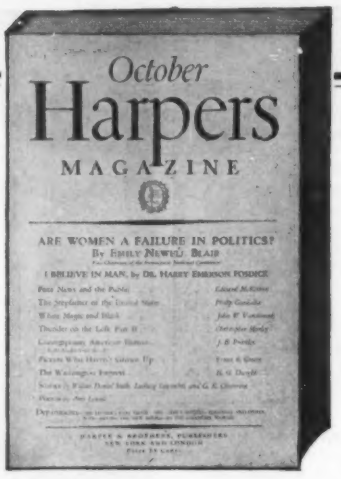

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The Contents *for October*

ARE WOMEN A FAILURE IN POLITICS? *by Emily Newell Blair*
Mrs. Blair, Vice-Chairman of the Democratic National Committee, answers the oft repeated question—"What have women done with the vote?"

RELIGION AS AN ADVENTURE, *by Dr. Harry Emerson Fosdick*
The second of this series of twelve articles on religion in everyday life.

FAKE NEWS AND THE PUBLIC, *by Edward McKernon*
An authoritative report—and excellent reading—on the baffling problem of market rigging plots and news fakes.

THE WASHINGTON EXPRESS, *by H. G. Dwight*
A felicitous mingling of delicate humor and tolerant wisdom from the man whose "Stamboul Nights" is a classic.

WHY PICK ON DAYTON? *by W. O. McGeehan*
Showing that the small town in Tennessee and elsewhere does not have more than its quota of morons.

THUNDER ON THE LEFT, *by Christopher Morley*
The second installment of Christopher Morley's masterpiece.

WHITE MAGIC AND BLACK, *by John W. Vandercook*
Miracles of the Suriname Jungle which pass the white man's comprehension.

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A sociologist who runs a clinic for "difficult" children discusses the disastrous mistakes made by modern fathers and mothers.

THE STEPFATHER OF THE UNITED STATES, *by Philip Guedalla*
A sympathetic, vivid, uncompromising portrait of George III presenting that unhappy monarch in a new light.

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given equations are satisfied the equation of the circle is also satisfied.

The equation

$$x^2 + y - 7 - m^2 (y^2 + x - 11) = 0$$

represents a conic section since it is an equation of the second degree in x and y. For certain values of m this conic section will degenerate into two straight lines.

We see at once that one of these equations must be of the form

$$x - m y + a = 0$$

and the other of the form

$$x + m y + b = 0,$$

since the term in x y must be wanting in their product.

Now we have

$$(x - m - y + a)\ (x + m y + b) = x^2 - m^2 y^2 + (a + b) x + (a - b) m y + a b = 0.$$

This equation must be identically equal to the conic section that is to degenerate into two straight lines and hence all of the coefficients of the powers of x and y must be equal in the two equations.

Therefore $a + b = -m^2$, $(a - b) m = 1$,

and $ab = 11 m^2 - 7$.

From these equations, we get

$$a = \frac{1 - m^2}{2 m}$$

$$b = -\frac{1 + m^2}{2 m},$$

hence $$ab = \frac{m^4 - 1}{4 m^2} = 11 m^2 - 7.$$

We thus have the equation

$$m^4 - 44 m^4 + 28 m^2 - 1 = 0,$$

from which to determine the value of m. This equation is of the third degree in m^2, hence there are three possible values of this multiplier that will reduce the conic section to two straight lines. These three roots are all real as is evident from the figure.

To solve this equation let us first assume

$$m^2 = p + \frac{44}{3}.$$

With this assumption, we get

$$(p + \tfrac{44}{3})^3 - 44\,(p + \tfrac{44}{3})^2 + 28\,(p + \tfrac{44}{3}) - 1 = 0,$$

or $$p^3 - \frac{1852}{3} p - \frac{159307}{27} = 0.$$

Since the three roots of this equation are real, it cannot be solved by Cardan's method. We can, however, easily solve it by trigonometry. Let $p = -n \sin e$, then we have

$$\sin^3 e - \frac{1852}{3 n^2} \sin e + \frac{159307}{27 n^3} = 0.$$

But in trigonometry we have the equation

$$\sin^3 e - \frac{3}{4} \sin e + \frac{1}{4} \sin 3e = 0.$$

By comparison of coefficients we see that the two equations will be identical if we assume

$$\frac{3}{4} = \frac{1852}{3 n^2}$$

and $$\frac{1}{4} \sin 3e = \frac{159307}{27 n^3}.$$

This gives us $$n^2 = \frac{7408}{9}$$

and $$\sin 3e = \frac{637228}{27} \left(\frac{9}{7408}\right)^{\frac{3}{2}}$$

$$\log 9 = 0.95424251$$
$$\log 7408 = 3.86970097$$
$$\log \left(\frac{9}{7408}\right) = 7.08454154 - 10$$
$$\log \left(\frac{9}{7408}\right)^{\frac{1}{2}} = 8.54227077 - 10$$
$$\log \left(\frac{9}{7408}\right)^{\frac{3}{2}} = 5.62681231 - 10$$
$$\log \frac{637228}{27} = 4.37293109$$
$$\log \sin 3e = 9.99974340 - 10$$
$$\log 637228 = 5.80429485$$
$$\log 27 = 1.43136376$$
$$\log \frac{637228}{27} = 4.37293109$$

From the trigonometrical tables we find that the angle corresponding to this log sin is

$$3e = 88^\circ\ 01'\ 50.25''$$

Therefore, e may have any one of the three values,

$$29^\circ\ 20'\ 36.75''$$
$$149^\circ\ 20'\ 36.75''$$
$$269^\circ\ 20'\ 36.75''$$

$$\log \sin 29^\circ\ 20'\ 36.75'' = 9.6902360 - 10$$

$$\log n = \operatorname{colog} \left(\frac{9}{7408}\right)^{\frac{1}{2}} = 1.4577292$$
$$\log (-p) = 1.1479652$$
$$p = -14.05935$$
$$-\frac{44}{3} = +14.66667$$
$$m^2 = +0.60732$$
$$\log m^2 = 9.7834176 - 10$$
$$\log m = 9.8917088 - 10$$
$$m = \pm 0.7793075$$

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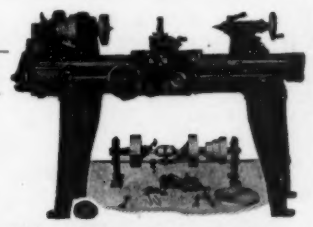

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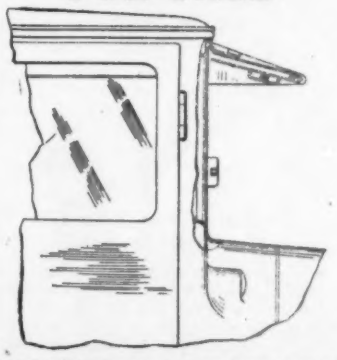

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This foremost authority presents in simple language a consideration of the atom, gases, liquids and solids and X-ray analysis. In his unique style he makes the profundities of science read like a tale of adventure. Published by Harper Bros. $3.20 postpaid.

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A readable non-scientific massing of the evidence which science has accumulated, demanding a theory for the proper relegation of the co-ordinate forms of diversified life. Reviewed in this issue. Published by The Bobbs-Merrill Co. $3.70 postpaid.

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Public Water-Supplies
By F. E. Turneaure and H. L. Russell

Studies of this kind are of interest to others beside the engineer, for we all are concerned about this vital element of civic life. Published by John Wiley & Sons. $6.20 postpaid.

[All the above books are obtainable from the Scientific American Book Department, 233 Broadway, N. Y. C.]

The other roots of the cubic may be computed by using the other two angles. This value of m is, however, the one that will give the best results.

If in the equations of the straight lines we substitute the values of a and b in terms of m, we get

$$x - m\,y + \frac{1 - m^2}{2\,m} = 0$$

$$x + m\,y - \frac{1 + m^2}{2\,m} = 0$$

If we substitute the positive value of m in these equations, we shall get the two straight lines that we require.

$$\log m = 9.8917088 - 10$$
$$\log m^2 = 9.6751264 - 10$$
$$m^2 = 0.473290$$
$$1 - m^2 = 0.526710$$
$$\log (1 - m^2) = 9.7215716 - 10$$
$$\log (2\,m) = 0.1927388$$
$$\log \left(\frac{1 - m^2}{2\,m}\right) = 9.5288328 - 10$$
$$\frac{1 - m^2}{2\,m} = 0.337935$$
$$\log 2 = 0.3010300$$
$$\log (2\,m) = 0.1927388$$
$$1 + m^2 = 1.473290$$
$$\log (1 + m^2) = 0.1682882$$
$$\log (2\,m) = 0.1927388$$
$$9.9755494 - 10$$
$$\frac{1 + m^2}{2\,m} = 0.945256$$

Therefore the two lines are

and $x - 0.77931\,y + 0.33793 = 0$
$x + 0.77931\,y - 0.94526 = 0$

The other two pairs of lines could be found in a similar manner but these two lines taken with either of the parabolas will give the four points of intersection. These two lines are shown on the diagram.

Let us find the intersection of the line

$$x - 0.77931\,y + 0.33793 = 0$$

with the parabola

$$y^2 + x = 11.$$

Substituting the value of x from the straight line, we get

$$y^2 + 0.77931\,y = 11.33793$$

$$y^2 + 0.77931\,y + \left(\frac{0.77931}{2}\right)^2 = 11.48976$$

$$y + \frac{0.77931}{2} = \pm\, 3.389655$$

$$y = +3 \text{ or } -3.77931$$
$$x = +2 \text{ or } -3.28318.$$

By using the other line, we get

$$y^2 - 0.77931\,y = 10.05474$$

$$y^2 - 0.77931\,y + \left(\frac{0.77931}{2}\right)^2 = 10.20657$$

$$y - \frac{0.77931}{2} = \pm\, 3.19477$$

$$y = +3.58443 \text{ or } -2.80512$$
$$x = -1.84812 \text{ or } +3.13132$$

Therefore the four points correct to at least the fourth decimal place are

1 $x = +2$, $y = +3$
2 $x = -1.84812$, $y = +3.58443$
3 $x = -3.28318$, $y = -3.77931$
4 $x = +3.13132$, $y = -2.80512$

Why Does Popcorn Pop?

G. C. S. asks: *"Why does Popcorn pop?" "What chemical or physical changes take place when corn pops?" "A few years ago Puffed Rice and Puffed Wheat were common breakfast foods. How was this 'puffing' accomplished? Was it a similar process to popping corn? Did it make the cereal any more digestible? Does the popping of corn make it more digestible than to eat it raw, for instance?"*

ANSWER: The reason for the popping of popcorn is that it contains moisture. When the corn is heated over the fire this moisture is turned into steam. Owing to the fact that the kernel of the corn is surrounded by a hard, dense shell this steam cannot escape. Therefore, the pressure rises, and when this pressure more than equals the strength of the shell the corn literally explodes. As a check on this phenomenon, if you will try to pop some corn which has been slowly dried you will find it does not pop.

Referring to the physical changes, the cells of the kernel containing moisture simply explode; regarding the chemical changes which take place I suggest that you communicate with the Department of Home Economics, Cornell University, Ithaca, N. Y., or with the United States Department of Agriculture.

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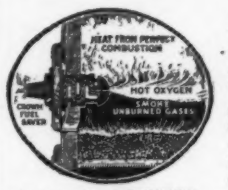

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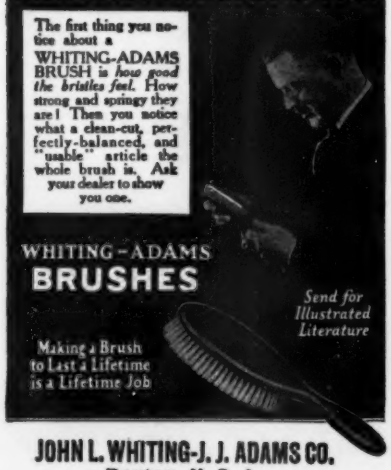

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under pressure; this pressure is then suddenly released. The result is a sudden explosion of the steam and gas inside the grains. The Nutrition Division of the Department of Agriculture has made numerous tests regarding the digestibility of puffed or popped corns.

Slow Motion Pictures

H. J. S. asks: *Are slow motion pictures taken with a camera at a high speed or slower than the ordinary kind?*

"At what speed (amount of times) per minute does a man take ordinary pictures and at what speed the slow motion?

ANSWER: The usual speed of operation is sixteen pictures per second, or a cranking speed of two turns per second. But there are times when certain trick effects are to be obtained, in which case a slower rate of taking is desirable. For such purposes every camera is provided with a second movement known as the single-picture or trick movement. The same crank can be removed from the usual crankshaft and placed on the trick shaft so as to take one picture for every turn. In filming scenes calling for high-speed action, the effect is produced by taking pictures at a rate of speed slower than the usual sixteen images per second, and when the same pictures are projected at the standard speed the action is accelerated proportionately. Likewise, in taking slow-moving pictures the rate of speed is accelerated beyond the usual sixteen images per second, and projected at standard speed.

The Lucky Ostrich

E. B. J. asks: *"Can an ostrich jump or swim?"*

ANSWER: An ostrich can both jump and swim.

Helium Not for Sale

H. T. of Stockholm, Sweden, *wants to get some helium.*

ANSWER: There is no helium for sale in the United States as the Government is the only organization extracting helium, and the Government cannot sell it, according to the law.

Etching Steel

A. P. M. asks: *"How can I etch steel?"*

ANSWER: While we have formulas which we have been recommending we thought it wise in this case to consult Mr. C. H. E. Redding, Editor of the *Brass World* and he gives us the following:

"To etch brands on polished knives:

Nitric acid	1 part
Hydrochloric acid	1 part
Water	10 parts

If too active dilute further.

"For a vertical bite:

Silver acetate	2 ounces
Distilled water	125 ounces
Alcohol	125 ounces
Nitric acid	65 ounces
Nitric ether	16 ounces

"To prepare nitric ether, mix one ounce of alcohol with one ounce of nitric acid and stop reaction by adding water.

"A very good one:

Iodine	4 ounces
Potassic iodide	10 ounces
Water	8 ounces

"Another etching fluid that is used for deeply etching on steel dies is made by using 10 parts 36 degrees nitric acid, 10 parts 66 degrees oil of vitriol, 10 parts 30 degrees hydrofluoric acid and 70 parts water. The above is too strong for etching thin steel like razor blades, steel rules, and so on, as the steel would get so hot that the wax would melt.

"For fine work the fluid must be diluted until it is adapted for the work. The etching fluid cannot be kept in anything but a wax bottle or pitch lined tank. To make the solution, pour the oil of vitriol in the water first, then add the nitric acid then the hydrofluoric acid."

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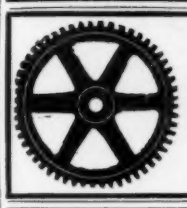

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Among the processes heralded as possible for the transmutation of one element to another that of Professor Miethe sounded most plausible. For the long and careful work leading to the failure to confirm this claim we are deeply indebted. The patience of our readers while the experiment was under way we appreciate.

Gold has not been made by this method. But will it ever be produced artificially? Perhaps. And when it is the Scientific American will tell you how.

ALCOHOL

CHEMISTS in the Bureau of Internal Revenue have a difficult job on their hands. For months they have been seeking some substance which, if put into commercial alcohol, would prevent its being used for beverage purposes when diverted into the hands of bootleggers. Quinine and other chemicals have been used, but it is a puzzle to get a specific that cannot be taken out by chemical processes. Patent medicines containing alcohol must be submitted to the Bureau to assure the chemists they cannot be used for beverage purposes; manufacturers are followed up to insure that no alcohol may get into bootleg channels.

While the Government, having commanded unalcoholic drinkables, now seeks undrinkable alcohol, the bootleggers seem to take for their slogan a modified version of the famous phrase of a famous orator, never noted for sobriety: "Alcohol and beverages, one and inseparable, now and forever."

HEARSAY

WE have all heard of hair turning white over night. Some awful accident or other harrowing experience had happened to someone, and when he next looked into a mirror, to his horror he discovered every hair had turned gray. But have any of us ever had this actually happen to us? We would like to hear from a man—or woman—whose hair had been suddenly shocked gray.

When you sift these sudden grayness tales down to the bottom, we think you will find that in each case, your informant did not actually see the event himself, but that someone else told him about a case of someone who had heard it from someone else. Dr. Hausman, a well-known zoologist who specializes in the study of hair of all kinds, says this sort of thing never happens.

What we would like to get track of is a real, *bona fide* case of this kind, at first hand, not second hand, nor even third hand. In the war, we saw a lot of men having gruelling experiences, but we do not remember a single case of hair suddenly becoming gray.

In This Issue

Gold from Mercury?

The results of the Scientific American's exhaustive test to establish the claims of Professor Miethe as a modern alchemist are described this month. Can gold be made by this method, the most plausible yet attempted by any scientist? The question is answered on pages 296 and 297.

Home-made Telescopes

Most of us would like to own a small astronomical telescope, but it would cost several hundred dollars. Up in Vermont, a group who were in this fix made their own instruments and had a lot of fun doing it. How they went at it is told by Mr. Ingalls—one page over.

Too Many Traffic Laws

A motorcycle officer says we have and he tells why he thinks so. Read his statements about the use and abuse of the speed trap and his reasons for suggesting that the speed limit for automobiles be raised. You will be interested, too, in the bail schedule for traffic violations. Page 318.

A Great Sun in Explosion

Last spring a faint star, billions of miles distant, blazed into sudden incandescence—the brightest object in the southern heavens. Astronomers have named it Nova Pictoris and tried to explain its mysterious explosion. Read what Professor Russell says about this new star on page 304.

A Lucky Accident

An ideal antiseptic that will kill germs without injuring the tissues—this for years was the quest of medical science. By pure accident such an antiseptic was found—common aniline dyes such as are used for dyeing cloth. Read the article on page 302.

MORE THAN 150 PICTURES

Complete table of contents will be found on page 360.

For Next Month

What the Air Races Taught Us

Professor Alexander Klemin, our aviation editor who will be one of the judges at the national air races next month will tell you some new facts about airplanes and flying—especially about the so-called "air flivvers."

Are All Spirit Photographs Fraudulent?

Is Sir Arthur Conan Doyle right when he talks about *genuine* spirit photographs? Dr. Walter Franklin Prince, a member of the Scientific American Psychic Committee, has prepared an interesting article on this subject, which you will find in the December issue.

An Aristocrat Among Furs

The little chinchilla, whose fur goes to make the most expensive of coats, is fast disappearing in its native Andes. Some of his family, Mr. Von Blon tells us, have been recently brought to the United States, in special cages equipped with ice compartments. These little immigrants form the nucleus of a growing colony, each member of which is worth almost his weight in gold.

Man Is What He Eats

In the last thirty years the average height of college students has increased one inch. Why? Professor Binder of New York University believes this is one of the many evidences that the future of our races is largely determined by their food. In our next issue he explains why.

Other articles on Seeing Speech; Where the Railroad Millions Go; A Bridge to Span the Grand Canyon; Buried Treasure; Radio; Astronomy.

MORE THAN 150 PICTURES

¶ ***None too soon to be thinking about Christmas presents. What could be a more delicate tribute to a friend's intellect than a year's subscription to the Scientific American? Send us his name now with a check for $4, so that he can start with the Christmas number.***

SAFETY

HOW would you like to feel when you take your seat in a train, whether by day or night, that if, as sometimes has happened, the engineer should be paralyzed or should die at his post when approaching a danger signal, the locomotive would, automatically, either slow itself down or come to a full stop in obedience to the signal? Such a system is at last being installed on our railroads, thanks to a long and for many years apparently hopeless agitation in its favor. The Scientific American feels particular interest and pleasure in this matter, for we were among the first, if not the first journal to point out the necessity for the automatic stop, and year after year urged its adoption, feeling assured that if our engineers and the inventors of the country gave themselves earnestly to the study of the problem it could be solved.

OUTCURVES

IS this or that scientifically possible, readers ask us. We give them the best answer science knows, and then fifty years later the ghost of our statement sometimes rises to plague us.

Recently on the sporting page of the *New York Telegram*, John Doyle, vice-president of A. G. Spalding and Brothers, was quoted as saying in a baseball article. "As late as July 28, 1877, it was still disputed that curves could be pitched. In the issue of the Scientific American for that date is a query asking if it is scientifically possible to pitch a baseball so as to describe a horizontal curve in the air. The editorial answer was: 'We have never seen it done.' This led to a long public discussion which finally resulted in a practical demonstration of curve pitching on the Cincinnati baseball grounds October 20, 1877."

Since that day we have seen curve pitching that seemed to us both science and art raised to its apex.

GROTESQUERY

AMONG all the grotesque engineering proposals which have found their way into the press, the scheme for building a double pier across the English Channel stands preeminent. From every possible point of view, such a structure would be utterly impracticable. The foundations, of enormous area, would have to be built, many of them, in 160 feet of water, and in a location where the tidal currents are swift.

If the foundations could be laid and the piers brought up to sea level, they would still have to be carried up at least 200 feet into the air to clear the masts of modern steamships; and even if the thing could be done and the viaducts were completed, they would practically close to navigation one of the busiest thoroughfares in the world. He would be a bold captain who dared to venture in heavy weather through the necessarily narrow openings. Why in the world do otherwise reputable papers lend their columns to the exploitation of schemes which are so utterly silly?

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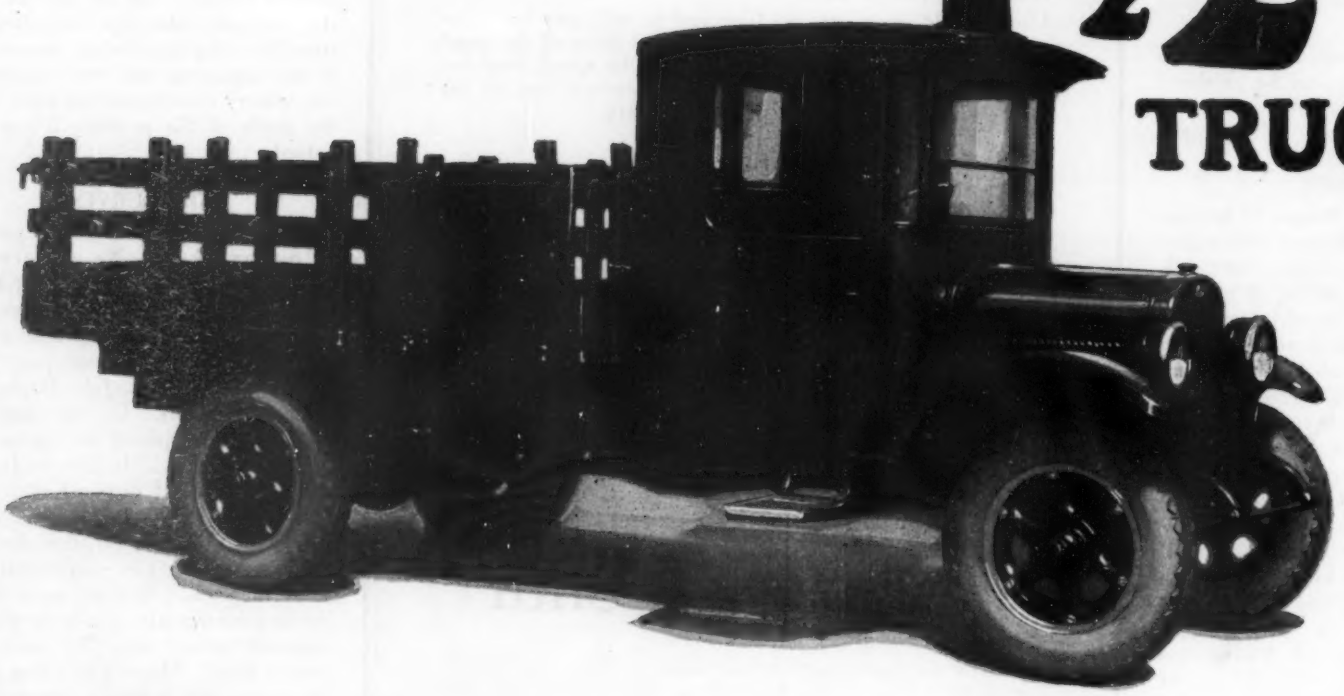

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